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HANDBOOK

SERVICE INSTRUCTIONS

SIGNAL GENERATOR AN/URM-33

(POLARAD)

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AND THE CHIEF OF THE BUREAU OF AERONAUTICS

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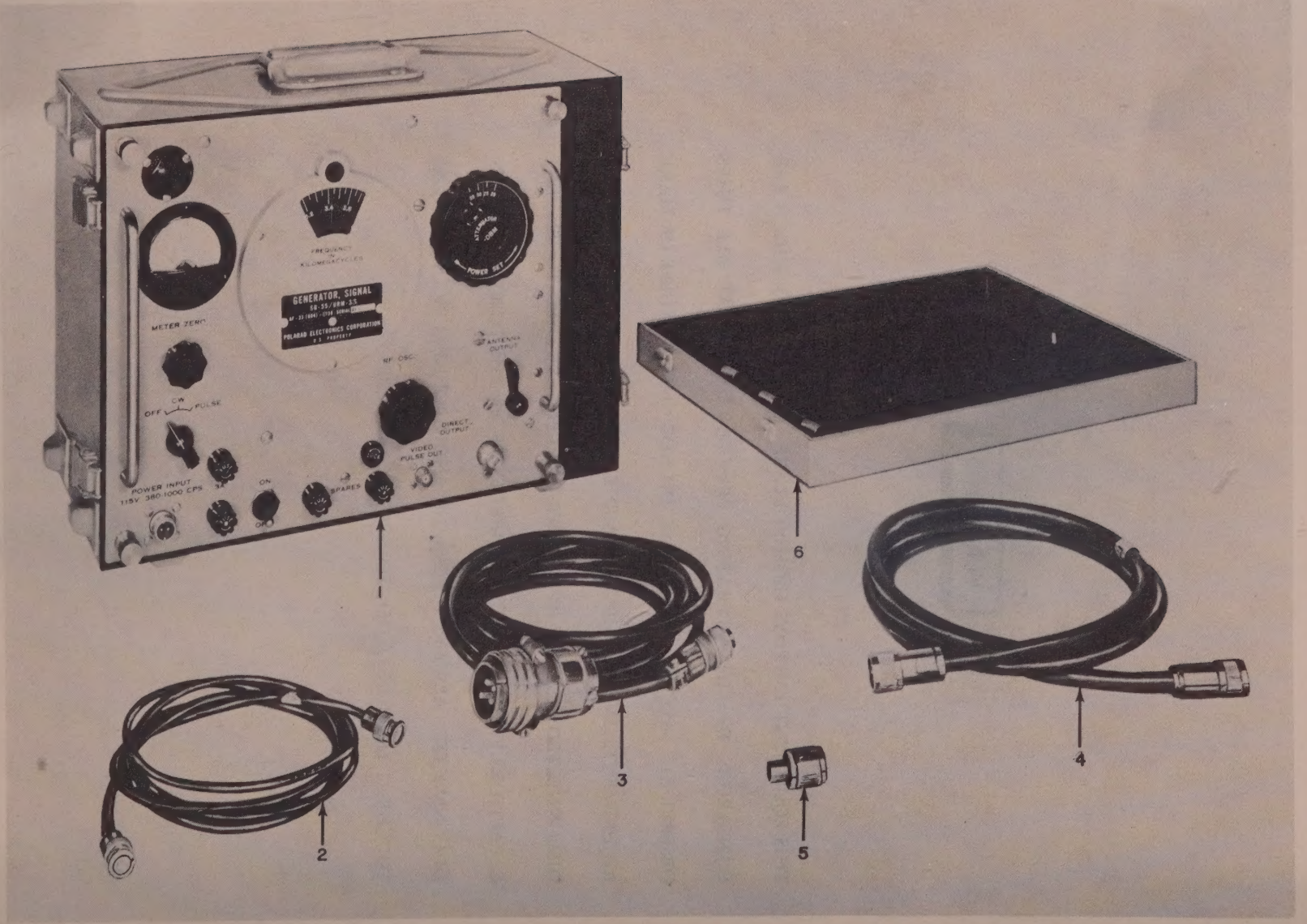
WARNING

THIS EQUIPMENT EMPLOYS HIGH VOLTAGES (1,000 VOLTS) WHICH ARE DANGEROUS TO LIFE. OPERATING PERSONNEL MUST AT ALL TIMES OBSERVE ALL SAFETY REGULATIONS. DO NOT CHANGE TUBES OR MAKE ADJUSTMENTS INSIDE THE EQUIPMENT UNLESS THE POWER CORD IS DISCONNECTED. ALTHOUGH BLEEDER CIRCUITS ARE USED TO PREVENT CAPACITORS FROM RETAINING CHARGES AFTER THE POWER HAS BEEN DISCONNECTED, ALWAYS DISCHARGE AND GROUND CIRCUITS BEFORE TOUCHING THEM IN ORDER TO AVOID CASUALTIES.



1. Signal Generator SG-54/URM-33
2. Cord CG-409C/U (6'0")
3. Power Cord CX-2470/U (10'0")
4. Cord CG-92B/U (6'0")
5. Adapter UG-273/U
6. Cover

Figure 1–1. Signal Generator AN/URM-33 Components

INTRODUCTION

These instructions are published for the information and guidance of field and service personnel responsible for proper maintenance of Signal Generator AN/URM-33. The symbols used on all schematic diagrams are those prescribed by JAN-STD-15. All abbreviations used are those approved and listed in ANA Bulletin No. 261.

SECTION I

DESCRIPTION AND LEADING PARTICULARS

1—1. PURPOSE OF THE EQUIPMENT.

1—2. Signal Generator AN/URM-33 is a microwave signal generator which provides video, continuous-wave and pulsed c-w signals. The outputs are used in pre-flight checking the system performance of broadband radar search and direction-finding equipment in the frequency range 1,000 to 2,300 megacycles per second.

1—3. The signal generator is manufactured by Polarad Electronics Corporation, Brooklyn, New York.

1—4. SCOPE OF THE HANDBOOK.

1—5. This publication comprises service instructions for Signal Generator AN/URM-33. A detailed explanation of the theory of operation of the equipment is given in section IV. Separate instructions are given for organizational and field service personnel in sections V and VI respectively, to enable them to perform repairs and make adjustments in accordance with the range of their activities. Sections I through VII of this handbook apply to Signal Generator AN/URM-33. Subsequent changes in the model will be treated in section VIII by the use of difference data sheets.

1—6. DESCRIPTION OF THE EQUIPMENT.

(*See figure* 1—1.)

1—7. Signal Generator AN/URM-33 consists of one each of the following components: Signal Generator SG-54/URM-33 mounted in a combination dust-cover and carrying case, Cord CG-92B/U (6′0″), Cord CG-409C/U (6′0″), Power Cord CX-2470/U (10′0″), and Adapter UG-273/U.

1—8. The signal generator is a completely self-contained compact unit. All operating controls, indicators, fuses, and receptacles are mounted on the front panel. Two handles on the front panel permit easy removal of the unit from the case and serve also to protect the front panel controls from damage. A handle on the top of the case is provided to facilitate lifting and carrying the unit in the case. To protect the unit when it is operated upright or on its side, a set of four feet is provided on the bottom and left surfaces of the case. These mounting feet, in addition, make it possible to polarize the antenna in both the vertical and horizontal plane. A window, in the back of the carrying case, covered with a protective teflon dielectric sheet, provides an aperture for the cavity-type antenna which is a part of the signal generator chassis. External cables are stored in a handy compartment in the side of the case. A cover which is attached to the case by means of pull-down latches, provides a convenient storage space for handbooks and four spline wrenches. The handbooks are held under a chart holder which is riveted inside the case cover. A schematic of the equipment is provided on the inside of the chart holder.

1—9. Weights and dimensions of the signal generator and its components are given in table I.

TABLE I. EQUIPMENT SUPPLIED

Quantity per Equipment	*Name of Component*	*Reference Symbol No.*	*Government Type Designation*
1	Signal Generator		SG-54/URM-33
1	Cord	W103	CG-92B/U (6′0″)
1	Cord	W102	CG-409C/U (6′0″)
1	Power Cord	W101	CX-2470/U (10′0″)
1	Adapter		UG-273/U

1—10. The signal generator contains a direct-reading frequency dial which is controlled over its entire range by a single knob. Continuous-wave, or pulsed c-w output can be fed to either DIRECT RF OUTPUT Receptacle J2 or to the built-in antenna for direct radiation into space.

1—11. A direct-reading calibrated attenuator controlled by the ATTENUATOR knob on the front panel makes it possible to obtain calibrated readings from 0 dbm to —100 dbm. The power reference level of one milliwatt is established by the POWER SET knob on the front panel as indicated by the power monitoring meter.

1—12. By means of Output Switch S3 (ANTENNA OUTPUT-DIRECT RF OUTPUT) the r-f signal may be fed either to Output Receptacle J2 (DIRECT RF OUTPUT) on the front panel, or to the antenna. The video signal is obtained at front panel Receptacle J4 (VIDEO PULSE OUT) when Function Switch S2 is in the PULSE position.

1—13. TUBE, FUSE, AND INDICATOR LAMP COMPLEMENT.

1—14. Table II lists the complete complement of electron tubes. Four 3-ampere fuses, Type F02G3R004 (F1 through F4), are located on the front panel in appropriately marked receptacles; two are spares. Indicator Lamp I 1, type AN3140-328, is used to illuminate the FREQUENCY IN KILOMEGACYCLES dial.

1—15. CAPABILITIES AND LIMITATIONS.

1—16. The capabilities and limitations of the signal generator are given in table III.

1—17. OPERATING CONTROLS.

1—18. Front panel operating controls, their function and location are described in table IV. All index numbers are those of figure 1—2.

TABLE II. TUBE COMPLEMENT

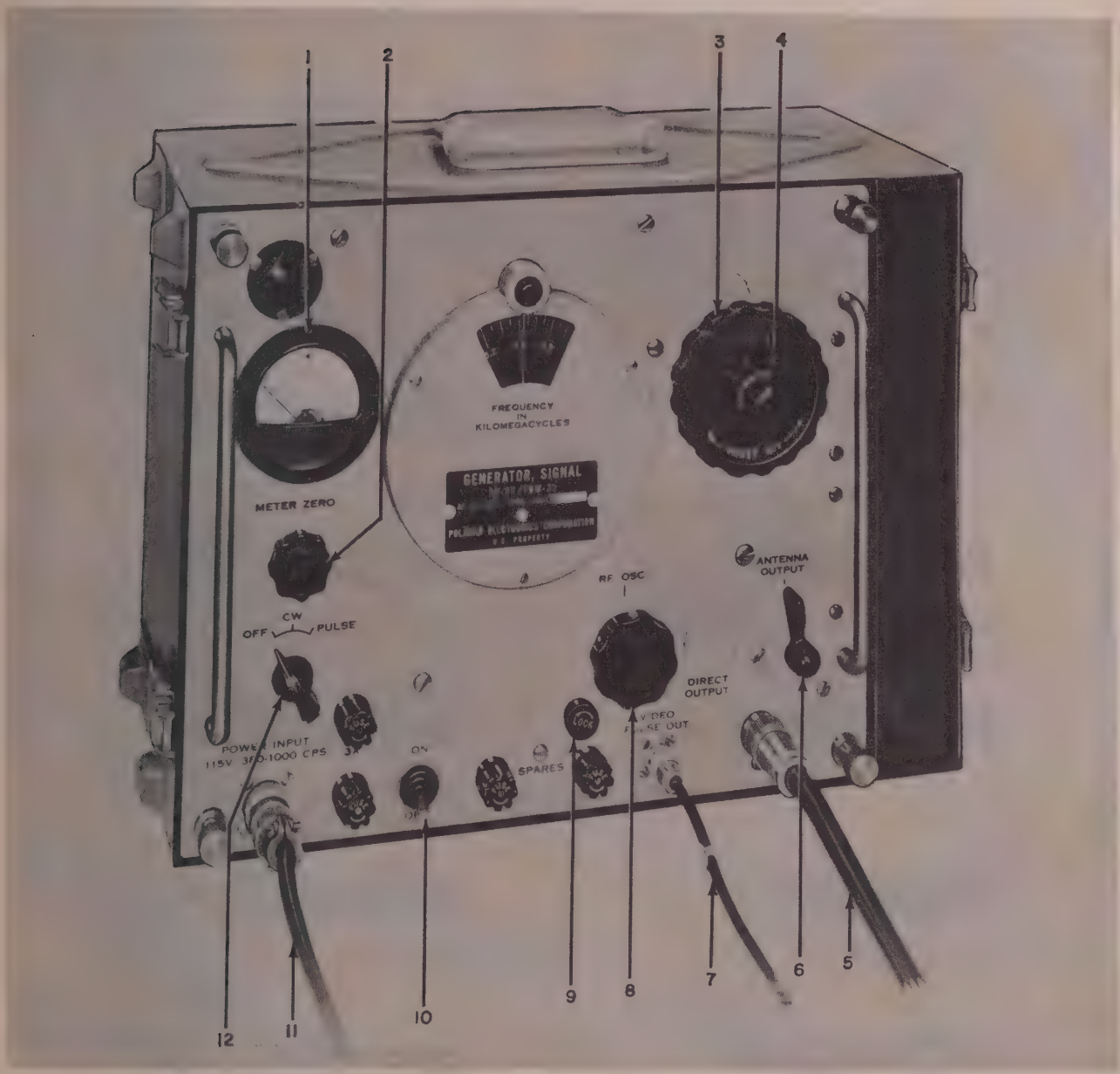
Ref. Symbol	*JAN Type*	*Quantity*	*Function*
V1, V8, V13	6X4W	3	V1, V13: Full-wave rectifier V8: Protective diode
V2	6005/6AQ5W	1	Series regulator
V3, V17	6AU6	2	Voltage control
V4, V14	OB2	2	Voltage regulator
V5, V6, V10, V11	12AT7	4	V5A: Pulse generator V5B: Pulse shaper V6: Keyer V10: Series regulator V11: Voltage control
V7	5837	1	Reflex oscillator, requiring external cavity
V9	5R4WGY	1	Full-wave rectifier
V12, V18, V19	5651	3	Voltage reference
V15	5Y3WGT-A	1	Full-wave rectifier
V16	6098/CT	1	Series regulator
CR1	1N69	1	Crystal diode

TABLE III. CAPABILITIES AND LIMITATIONS

Characteristic	*Capability or Limitation*
Frequency range	1,000 mc to 2,300 mc
Frequency stability	C-w—.025% incidental frequency modulation or less Pulse—0.2% frequency shift or less, at operating frequency
Modulation	Repetition rate—1,000 ± 100 pulses per second Pulse width—3 ± .5 μs at 50% peak amplitude points Pulse rise and decay time—0.35 μs measured between 10 and 90% amplitude points
Video pulse amplitude	1.25 ± 0.5 volts terminated into a 50 ohm resistive load
Output impedance	VIDEO PULSE OUT—50 ohms, resistive DIRECT RF OUTPUT—50 ohms
Power output	Continuously variable from 0 to —100 dbm ± 3 db
Antenna beam width	15° minimum at half-power points
Power requirements	270 watts max at 115 volts ± 10%, 380 to 1,000 cps

TABLE IV. OPERATING CONTROLS

Index No.	*Control*	*Function*
2	METER ZERO	Adjusts bridge voltage supply to balance the bridge circuit as indicated by the deflection of the meter needle to its ZERO position.
3	POWER SET	Adjusts the position of the thermistor probe in waveguide W6 to set the one-milliwatt power reference level. This is indicated on the meter when the needle deflects to the CAL mark.
4	ATTENUATOR (—DBM)	Adjusts the position of the attenuator probe in waveguide W5 to obtain the desired r-f output level. The dial at the same time indicates attenuation directly in —dbm (decibels below one milliwatt).
6	Output Switch S3 (ANTENNA OUTPUT/ DIRECT RF OUTPUT)	Permits the r-f output to be fed either to DIRECT RF OUTPUT Receptacle J2 on the front panel in DIRECT RF OUTPUT position or to the antenna in ANTENNA OUTPUT position.
8	RF OSC control	Simultaneously drives reflex klystron tuning mechanism, frequency dial, and repeller voltage tracking potentiometer to tune the klystron. The frequency dial indicates the frequency in kilomegacycles.
9	LOCK	The LOCK knob in its maximum clockwise position locks the shaft rotation of the RF OSC control shaft.
10	POWER Switch S1 (ON-OFF)	Applies and removes nominal 115-volt a-c power to power transformers, time delay relay, blower motor, and frequency dial light.
12	Function Switch S2 (OFF-CW-PULSE)	Selects the type of output: Continuous wave in the CW position and pulse modulation in the PULSE position. In OFF position the signal generator is in standby operation and the klystron is at cut-off, permitting the bridge circuit to be balanced.



1. Meter, M1
2. METER ZERO, R64
3. POWER SET
4. ATTENUATOR (—DBM)
5. Cord, W102
6. Output Switch, S3
7. Cord, W103
8. RF OSC Knob
9. LOCK
10. Power Switch, S1
11. Power Cord, W101
12. Function Switch, S2

Figure 1–2. Signal Generator Front Panel Controls

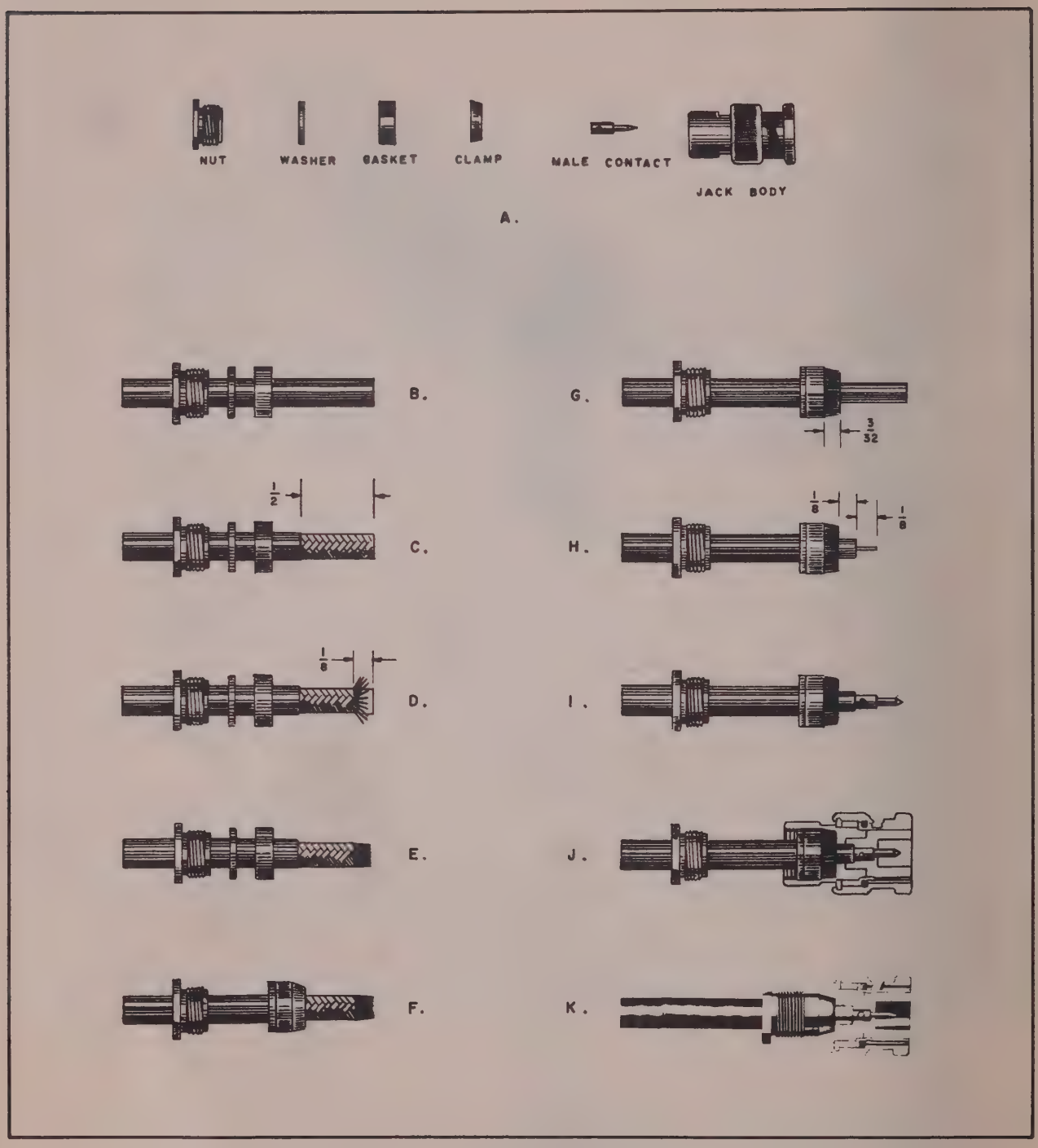


Figure 2–1. Fabrication Details, Type BNC Connector Assembly

SECTION II
TEST EQUIPMENT AND SPECIAL TOOLS

2—1. GENERAL.

2—2. This section describes the test equipment and tools required for the disassembly, reassembly, and testing of the signal generator as given in sections V and VI of this handbook.

2—3. TEST EQUIPMENT.

2—4. Table V, Test Equipment Required For Maintenance, lists test equipments recommended by the manufacturer of the signal generator for use in the tests described in sections V and VI of this handbook.

2—5. TOOLS.

2—6. TOOLS SUPPLIED. Four Bristol (spline) setscrew wrenches (Nos. 4, 6, 8, and 10) are supplied with the equipment. They are mounted inside the case cover.

2—7. TOOLS REQUIRED BUT NOT SUPPLIED. In addition to the tools supplied, a vernier depth calipers and a spanner wrench (2 inch maximum jaw opening) are required for maintenance.

2—8. CABLE FABRICATION.

2—9. The bench tests described in section VI require, in some cases, the fabrication of special cables to connect the signal generator video output to various kinds of test equipment. Instructions are given in the following paragraphs for connecting a BNC plug to a video cable. Cable termination at the other end depends on the test equipment receptacle.

2—10. CONNECTING A BNC CONNECTOR TO A MATING CABLE. (See figure 2—1.) To connect a BNC Type UG-88/U connector to a Type RG-58C/U cable, proceed as follows:

a. Disassemble the plug as shown in A. Cut the end of the cable clean.

b. Slip the nut, washer and gasket on cable as in B. Remove ½ inch of the vinyl jacket exposing the braid as shown in C. Exercise care not to nick the braid.

c. Push the braid back, and remove ⅛ inch of insulation and conductor as shown in D.

d. Pull the braid back over the end and taper the braid as shown in E.

e. Slip the bushing on to the cable as shown in F.

f. Fit the inner shoulders of the clamp squarely against the end of the jacket and slide the washer and gasket up against the clamp as shown in F.

g. With the sleeve in place, comb out the braid, fold back smooth as shown in G and trim 3/32 inches.

h. Allow ⅛ inch of insulation and bare the center conductor as shown in H.

i. Tin the center conductor. Slip the male contact in place and solder as shown in I. Remove excess solder. Be sure cable dielectric is not heated excessively, inasmuch as it may swell and enter the plug body.

j. Push the assembly into the plug body as far as it will go, as shown in J. Slide the nut into the body and screw into place with a wrench until moderately tight. Hold the cable and shell rigidly and rotate the nut as far as it will go. The final assembly of the termination is shown in K.

2—11. CONNECTING TEST LEADS TO THE CABLE. To terminate the other end of the cable with test leads, proceed as follows:

a. Remove about 2 inches of the outer vinyl jacket, revealing the braid. Do not nick the braid.

b. Pull the braid back and remove 1 inch of the inner insulation exposing the inner conductor. Pull the braid back over the inner conductor.

c. Make a hole in the braid about ¼ inch from the beginning of the vinyl jacket, large enough to pull the inner conductor through it.

d. Pull the inner conductor and insulation through the hole.

e. Solder one alligator clip to the inner conductor and another to the braid.

TABLE V. TEST EQUIPMENT REQUIRED FOR MAINTENANCE

Name	*AN Type or Mfg's. designation*	*Alternate*	*Use*
Voltmeter 20,000 ohms-per-volt	Multimeter TS-352/U	Simpson Model 260 Weston Model 270	Checking voltages and resistances
Frequency Meter	TS-186A/UP		Recalibrating frequency dial and frequency range
Coaxial Crystal Detector	Hewlett-Packard Model 420A or equal with DC return path		R-f envelope detector
Bolometer	PRD-627A		R-f power measurement
Power Bridge	PRD-650A or equal (full scale one-milliwatt)		Recalibrating POWER SET control and ATTENUATOR dial
Oscilloscope	TS-239/UP	Waterman Model S-5-A, Tektronix Type 514A or DuMont Type 294A	Checking waveforms
Oscilloscope	DuMont Model 304A		Recalibration of pulse repetition rate
Frequency Counter	Hewlett-Packard Model 524A	Berkeley 554	Recalibration of pulse repetition rate
Audio Oscillator	Hewlett-Packard Model 200C		Recalibration of pulse repetition rate

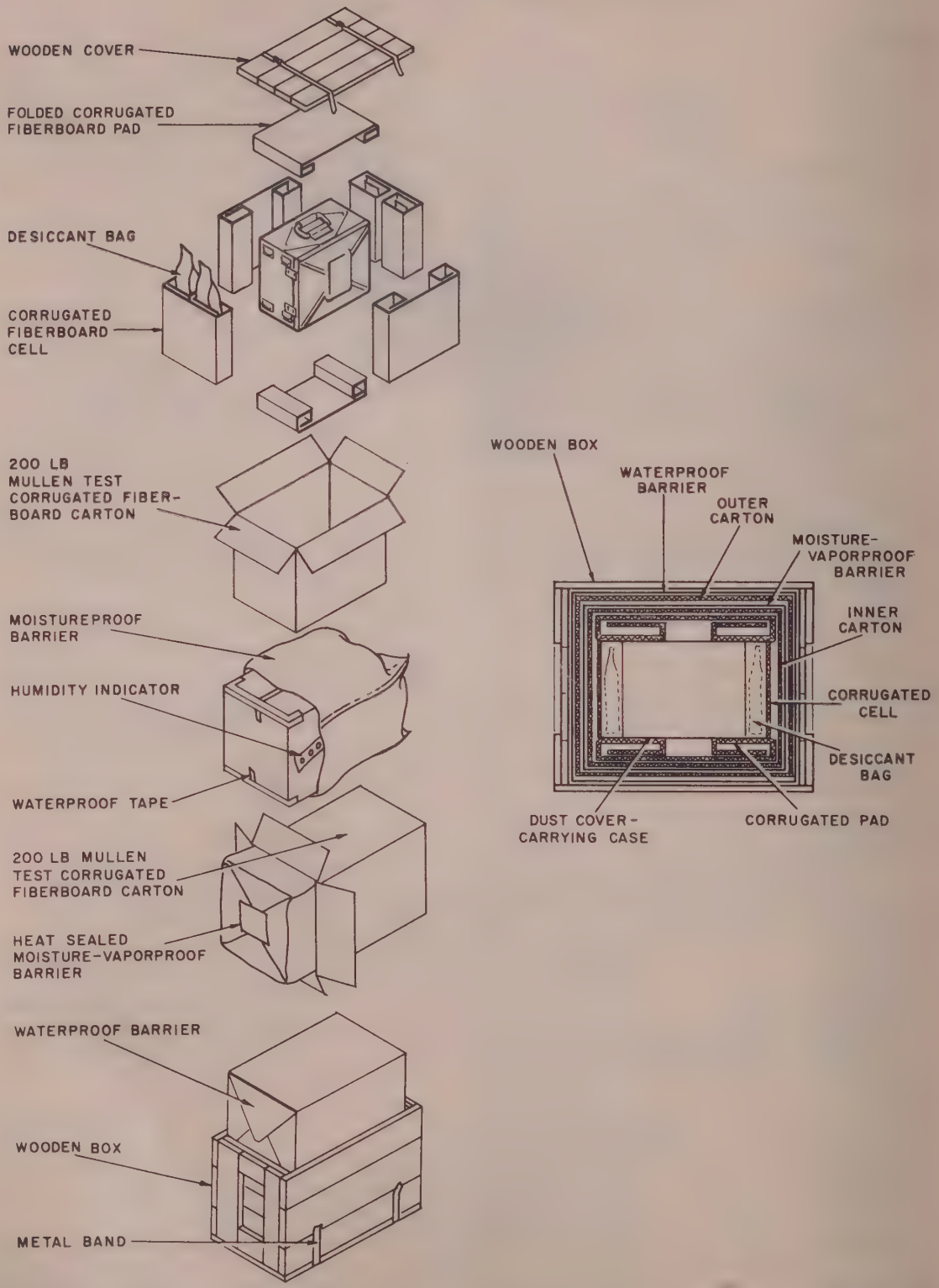


Figure 3–1. Packing Details

SECTION III

PREPARATION FOR USE AND RESHIPMENT

3–1. PREPARATION FOR USE.

3—2. Signal Generator AN/URM-33 is complete in one portable unit and is ready for use upon delivery. No permanent or special installation procedures are necessary.

3—3. UNPACKING THE EQUIPMENT. All items listed in table I are placed in the carrying case, the cover is placed on the case and the snap locks are secured. The packing details are illustrated in figure 3—1. Store the cartons and corrugated fillers for future use.

3—4. OPERATION. No special procedure is required for setting up the unit other than its connection to a suitable power source. For operation of the equipment, refer to the applicable "Handbook Operating Instructions".

3–5. PREPARATION FOR RESHIPMENT.

3—6. Packing the equipment for reshipment requires no special procedures. Remove all cables and cords and stow them in case compartment. Place handbooks under the chart holder which is riveted to the cover. Carefully repack the equipment by following the instructions noted in figure 3—1.

SECTION IV

THEORY OF OPERATION

4–1. GENERAL.

4—2. The AN/URM-33 Test Set is a continuous-wave and pulse modulated continuous-wave signal generator which can provide a signal of known intensity and frequency in the range of 1.00 to 2.30 kmc. Essentially the signal generator consists of a reflex klystron r-f oscillator assembly, a modulator circuit and four power supplies to provide the necessary supply voltages. Refer to figure 4—1 for the simplified block diagram.

4—3. The klystron r-f oscillator assembly consists of a reflex klystron tube and associated external cavity which generate the desired signal; a power monitor which measures the c-w output; and a calibrated attenuator which couples the r-f signal (via Output Switch S3) to either the antenna or the DIRECT RF OUTPUT Receptacle J2.

4—4. The RF OSC knob controls the movement of a non-

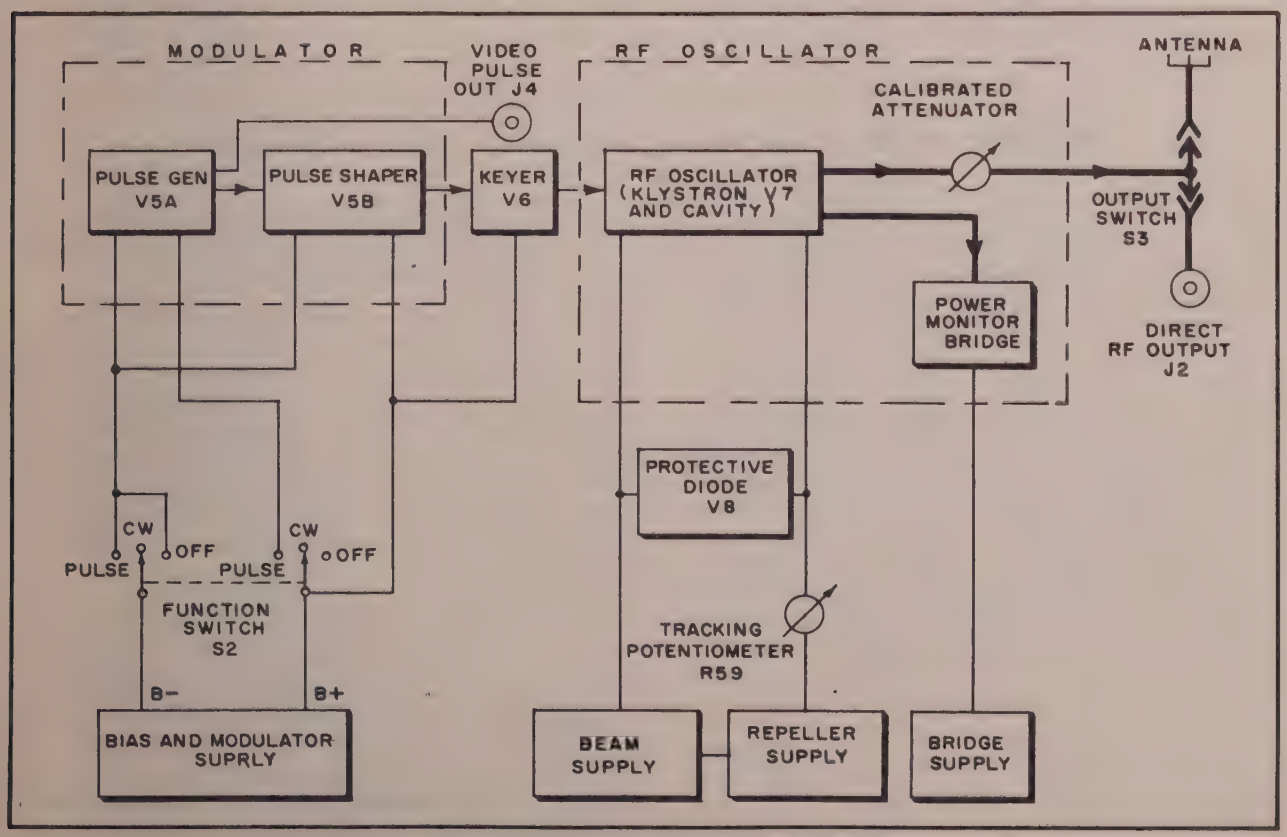


Figure 4–1. Simplified Block Diagram

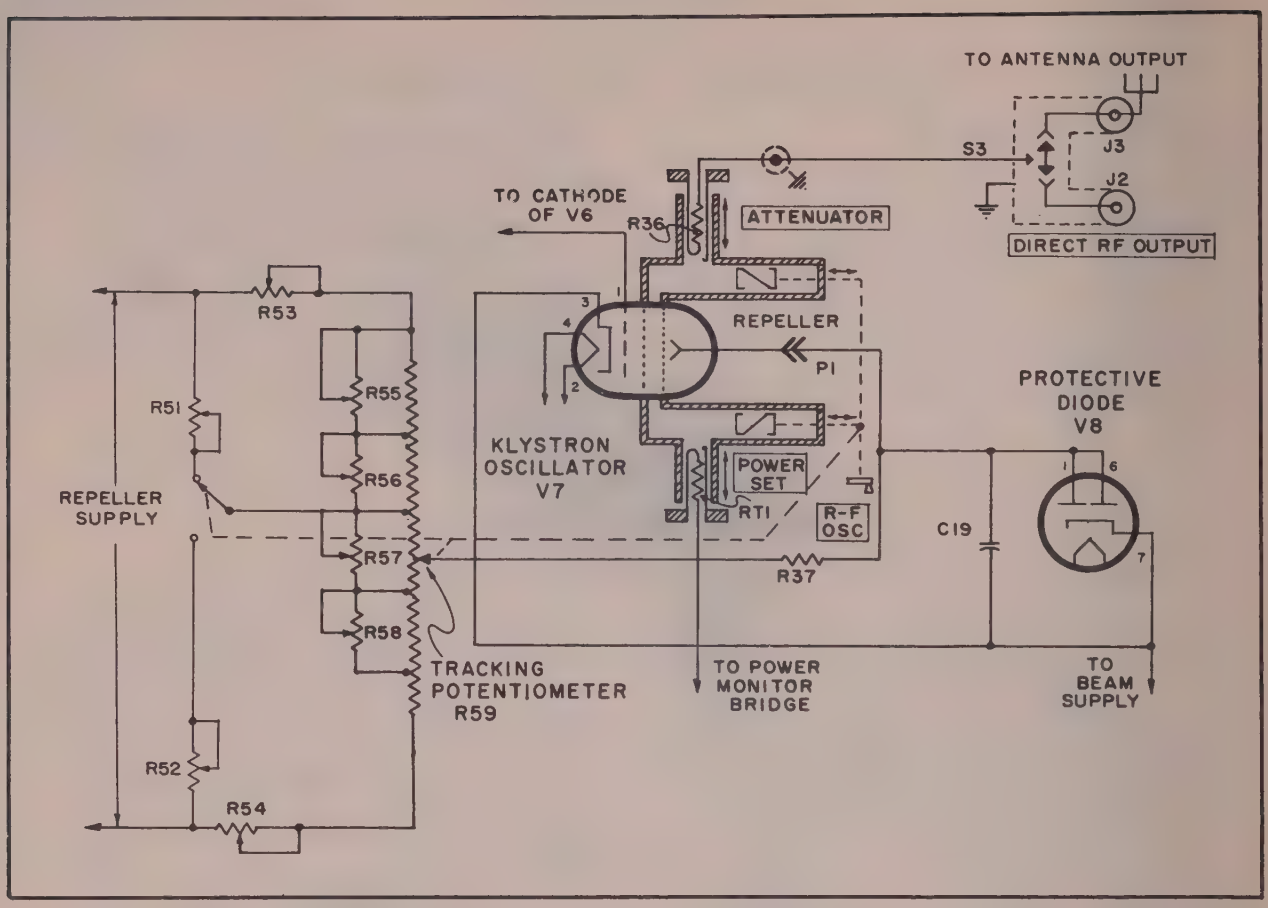


Figure 4—2. Oscillator and Tracking Potentiometer, Simplified Schematic

contacting plunger within the cavity thus changing the effective length of the short-circuited coaxial-line section that controls the frequency of oscillation. Simultaneously, this control adjusts the tracking potentiometer which varies the klystron repeller voltage to insure operation within its repeller mode.

4—5. The power monitor consists of a bridge circuit wherein a sliding thermistor probe (positioned by the POWER SET control) is one arm of the bridge. The probe is located in one of the two waveguides-beyond-cutoff tubes which project from the sides of the oscillator cavity. A loop at the end of the thermistor probe absorbs r-f power which affects the resistance of the thermistor. Consequently, the bridge is unbalanced and a deflection on the meter is noted. The one-milliwatt power reference level is established, first, by balancing the bridge and second, by adjusting the thermistor probe until the pointer on the meter deflects to the CAL position.

4—6. A sliding pickup loop in the other waveguide-beyond-cutoff tube adjusts the r-f power output. This adjustment is controlled by the front panel ATTENUATOR knob. When the power reference level has been set, and the —DBM dial reads "0", one milliwatt of r-f power is available at either the built-in antenna or the DIRECT RF OUTPUT Receptacle, J2, depending upon the position of Output Switch S3.

4—7. When Function Switch S2 is in PULSE position, the negative bias (beyond-cutoff) on the grid of the klystron keeps the tube from oscillating until it is keyed by the output pulse formed by the pulse-modulating circuits. Thus a train of r-f oscillations, with a flat-top envelope, for a duration equal to the width of the modulating pulse is generated. Simultaneously, a video pulse having the same waveshape and repetition rate as the r-f pulse is provided at the VIDEO PULSE OUT Receptacle J4 on the front panel.

4—8. Four separate power supplies are incorporated in the signal generator: 1. — BEAM SUPPLY — provides the necessary cathode voltage for the klystron; 2.—REPELLER SUPPLY—provides the necessary voltage to the tracking potentiometer which varies the voltage applied to the klystron repeller; 3.—BIAS AND MODULATOR SUPPLY—provides the grid bias for the klystron and the supply voltage for the modulator circuit; and 4.—BRIDGE SUPPLY—provides the necessary voltage for the power monitoring circuits.

4—.9 FUNCTIONAL OPERATION OF ELECTRONIC AND ELECTRICAL COMPONENTS.

4—10. GENERAL. The signal generator is capable of two types of output, cw and pulse. Function Switch S2, designated OFF-CW-PULSE on the front panel, selects c-w operation in the CW position and pulse-modulated cw in the PULSE position. In OFF (standby) position of the function switch, the klystron is cut off and the power bridge circuit may be balanced, by METER ZERO potentiometer, R64, before application of r-f power. A 3-microsecond flat-topped pulse is available at VIDEO PULSE OUT Receptacle J4, when Function Switch S2 is in PULSE position.

4—11. CW OPERATION.

4—12. In c-w operation, Function Switch S2 is set to CW position. The power output is generated by the klystron oscillator circuit.

4—13. KLYSTRON OSCILLATOR CIRCUIT. The klystron oscillator circuit is that of a velocity modulation tube V7, a type 5837, operating in an external resonant cavity. (See figure 4—2.) The cavity employed is in the form of a coaxial transmission line, and consists of two cylinders, one inside the other. The klystron tube is inserted at one end of this line so that the outer cylinder makes contact with the first interaction grid (so termed because it is closer to the cathode), while the inner cylinder makes contact with the second interaction grid. At the other end, the circuit is completed by a movable non-contacting shorting plunger of special construction. The position of this movable short determines the resonant frequency of the cavity. Two waveguide-beyond-cutoff tubes projecting from opposite sides of the cavity permit the coupling out of r-f energy to the attenuator and the power monitor.

4—14. The cathode of tube V7 is fixed, while the repeller voltage is varied by the tracking potentiometer as the operating frequency is changed. The maximum repeller voltage is limited by the repeller supply and the setting of R54, while the minimum is determined by the setting of R53. Thus the repeller is always maintained negative with respect to the cathode. Hence, the electrons that pass through the resonator grids encounter a strong decelerating field and are slowed to a stop, and then are accelerated in the reverse direction towards the cathode. A bunching process is thus caused by the accelerating and decelerating action. If the r-f energy extracted from the electrons by the cavity on the return trip exceeds that lost in the cavity, the excess energy is available as useful output power and the tube functions as an oscillator. In order to maintain the proper phase between the r-f oscillations and the return of bunched electrons to the cavity as the frequency is changed, the plunger is ganged with tracking pot R59 which con-

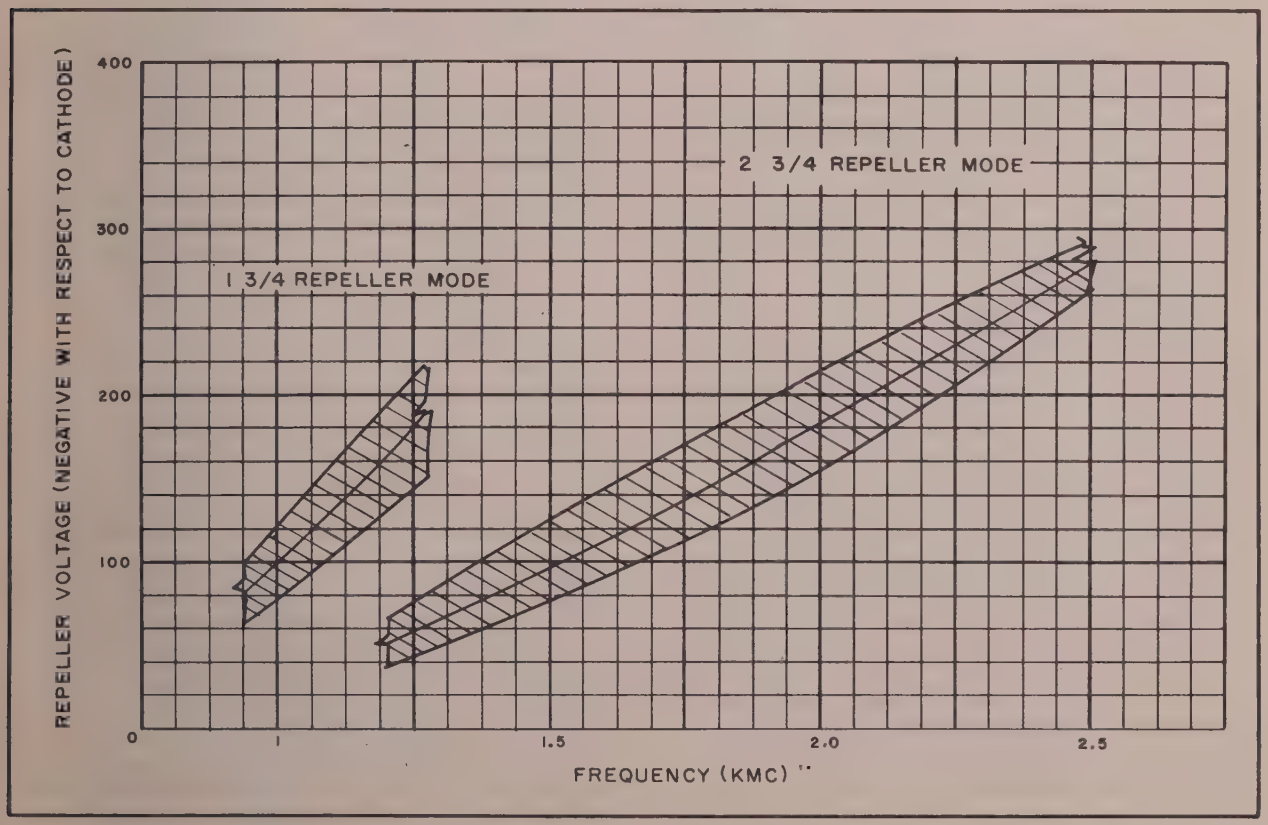


Figure 4—3. Typical Mode Plot

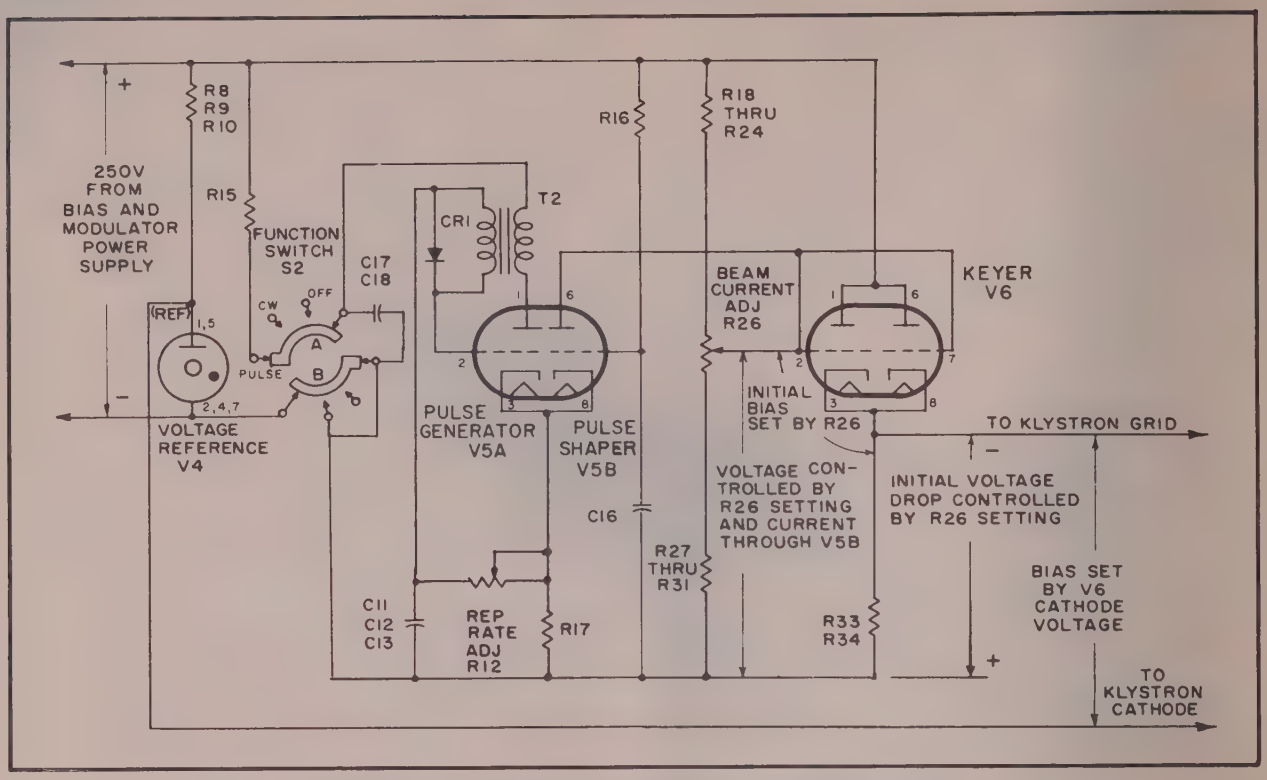


Figure 4—4. Modulator Circuit, Simplified Schematic

stitutes the bleeder for the klystron repeller supply. Protective diode V8, a 6X4W duo-diode, is connected between the cathode and the repeller. This tube serves to keep the repeller from going positive with respect to the cathode.

4—15. The necessary conditions for oscillation at resonant frequencies are obtained when the klystron oscillator is operated in the 1¾ and 2¾ cycle repeller mode and the ¼ wavelength cavity mode. Figure 4—3 is a graph showing oscillating frequencies plotted against a range of repeller voltages. This cavity frequency characteristic curve represents the repeller mode as it is determined by the tracking of the plunger (choke) and potentiomter R59 with the setting of potentiometers R55 through R58 (TRACK 1 through TRACK 4). Potentiometers R53 and R54 set the low and high voltage limits respectively.

4—16. The keyer (V6) circuit (fig. 4—4) acts as a bleeder across the 250-volt bias and modulator supply to provide a low impedance cathode follower output to the klystron grid. The current drawn by the klystron tube is determined by the keyer cathode voltage level which is identical to the grid-to-cathode voltage on the klystron. This required level is obtained by the setting of the BEAM CURRENT ADJ. potentiometer R26.

4—17. STANDBY OPERATION (OFF position of Function Switch S2).

4—18. In standby operation Function Switch S2B closes and applies voltage to the cathode of pulse shaper V5B. The plate of V5B is connected into the circuit across part of R26 and parallel bleeder resistors R27 through R31. V5B draws current—the drop across parallel bleeder resistors R18 through R24 increases—and the keyer (V6) grid voltage becomes more negative. This negative change causes less current to flow through V6 thereby reducing its cathode voltage. This voltage applied to the klystron grid is sufficiently negative with respect to its cathode to cut off the tube.

4—19. PULSE OPERATION.

4—20. The pulse generator operates only when Function Switch S2 is in PULSE position. (See figure 4—4.) In this position of the switch, its plate circuit is closed by S2A, and its cathode circuit is closed by S2B. The pulse generator uses a free-running blocking oscillator circuit to obtain a pulsed output. The pulse repetition rate is determined by the setting of REP RATE ADJ potentiometer R12 and by capacitors C11, C12 and C13 which together form the RC network. Crystal unit CR1, a JAN type 1N69, serves to correct overshoot in the pulse. A tertiary winding on the blocking oscillator transformer T2 couples to the VIDEO PULSE OUT receptacle a nominal 1.25 volt video pulse which has the same 3-microsecond width waveform and 1,000 pps repetition rate characteristics as the r-f pulse.

4—21. The pulsed output of the pulse generator is coupled to the pulse shaper by their common cathode resistor, R17. The pulse shaper circuit uses cutoff limiting to flatten the positive top of its plate waveform. Limiting is achieved by using the positive pulse developed by V5A

to drive the cathode of pulse shaper V5B positive with respect to its grid. Thus V5B, which is normally conducting, is cut off. The voltage at the arm of R26 returns to the value originally set for CW operation and the klystron oscillates for the duration of the pulse. The high impedance plate circuit of V5B is matched to the low impedance grid circuit of klystron tube V7 by using V6 as a cathode follower.

4—22. The keying of the klystron produces a flat-topped envelope containing a train of pulsed c-w signals. The 3-microsecond wide envelope is reproduced at a repetition rate of 1,000 pps.

4—23. ATTENUATOR.

4—24. The function of the attenuator is to couple the signal to the output. The attenuator consists of a circular waveguide operated below cutoff, in which the free-space wavelength is large compared with the diameter. The waveguide is mounted on the klystron cavity. Electromagnetic energy launched into the waveguide is attenuated exponentially over its length because the inside diameter of the waveguide is smaller than the cutoff value. By the introduction of a probe assembly which slides inside the waveguide tube, the total attenuation is made variable. Output Switch S3, a coaxial type r-f switch, makes the attenuated signal available either at the DIRECT RF OUTPUT jack on the front panel or at the built-in antenna.

4—25. The desired mode for the waveguide-beyond-cutoff tube is the TE_{11} and is excited therein. A probe tip assembly is inserted into the waveguide tube. Movement of this assembly is controlled by the ATTENUATOR knob through a rack and pinion gear. (Refer to paragraph 4—46.) Above the knob, a dial indicator (—DBM) affords direct reading of the attenuation level in graduations from 0 to 100 decibels below one milliwatt. The setting of the one-milliwatt reference level is a function of the power monitoring circuit which is discussed in paragraphs 4—26 through 4—29.

4—26. POWER MONITORING CIRCUIT.

4—27. The r-f power monitoring circuit (fig. 4—5) consists of a Wheatstone type bridge that measures power by the use of a variable resistance element (thermistor) in a bridge circuit. A thermistor has a negative temperature coefficient of resistance; i.e., as the temperature increases the resistance decreases, and vice versa. Changes of thermistor temperature and hence resistance are governed by three factors—by thermal changes in its environment, by the current flowing through it, and by absorbed r-f power. By controlling two factors, current and ambient temperature, the bridge will determine the r-f power by measuring the change in thermistor resistance caused by the applied power.

4—28. Two types of thermistors are used in the signal generator—the bead (RT1) and the disc (RT2 and RT3). The bead thermistor, used for power measurement, has a small mass and is affected by all the changes mentioned above. The disc thermistor, used in compensating networks, has a large mass; its resistance is relatively insensitive to the current flowing through it and is dependent, primarily, on the ambient temperature.

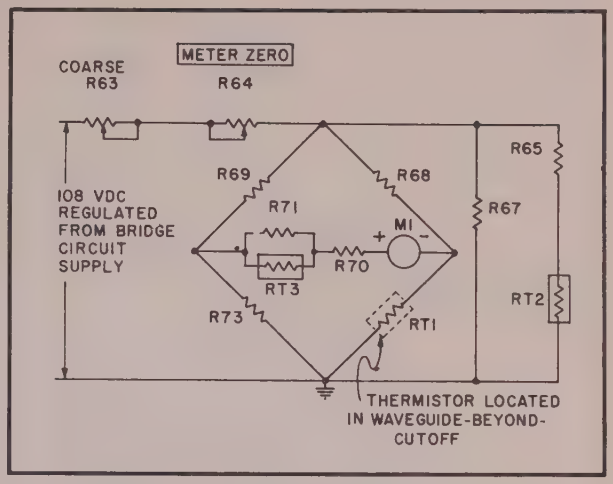


Figure 4—5. Power Monitoring Circuit, Simplified Schematic

4—29. The basic bridge circuit, consisting of resistors R69, R73, R68 and bead thermistor RT1, (RT1 is a part of the thermistor probe assembly located in the waveguide-beyond-cutoff tube) is balanced (ZERO on meter) by adjusting the METER ZERO potentiometer R64 (located on the front panel) and the COARSE potentiometer R63 (located on the rear of the panel). The COARSE potentiometer is factory adjusted to permit the METER ZERO potentiometer to cover the entire operating range. After the meter has been ZERO SET, any r-f power fed into the waveguide-beyond-cutoff tube will be absorbed by the bead thermistor and thus unbalance the bridge. The bridge is so designed that for a given frequency the bead thermistor (probe assembly) must be inserted into the waveguide a definite amount so that one milliwatt of r-f power will be indicated by the CAL mark on the meter. Movement of the bead thermistor is controlled by the POWER SET knob on the front panel through a rack and pinion gear (par. 4—45). Because of two distinct disadvantages of the basic bridge circuit, meter sensitivity changes and dc drift due to temperature changes, compensating disc thermistors are used. The function of disc thermistor RT3 is to compensate for the variation in meter sensitivity due to changes in ambient temperature while RT2 is used to correct for any dc unbalance due to ambient temperature changes. In order to adjust this compensation to cover the required temperature ranges, RT3 is combined in a network with resistors R71 and R70, whereas RT2 is combined with R65 and R67. The disc thermistors are located on a thermistor mount (CP2) which is clamped to the thermistor waveguide tube.

4—30. POWER SUPPLIES.

4—31. Operation of the klystron oscillator and the modulator circuit is made possible by four different power supplies: the beam supply, the repeller supply, the bias and modulator supply, and the bridge supply. (See figures 4—6 and 7—4.) The first three supplies are electronically regulated and inter-referenced as shown in the block dia-

gram (fig. 4—6). Inasmuch as the interaction grids of the klystron make contact with the klystron oscillator cavity, these grids are kept at ground potential to avoid the application of high voltages to the cavity, and the cathode is made negative with respect to ground. This is accomplished by tying the negative side of the beam supply to the cathode and the positive side of the supply to ground. In order to make the repeller voltage negative with respect to the cathode, the positive side of the repeller supply is tied to the negative output of the beam supply. The output of the repeller supply is thus always negative with respect to the klystron cathode. The bias and modulator supply is referenced to the klystron cathode at the junction of parallel resistors R8, R9, R10, and voltage regulator V4, to allow positive and negative control of the klystron grid. The fourth power supply is the bridge circuit supply. It is 108 volts positive with respect to ground, and furnishes a d-c balancing voltage to the power monitor circuit.

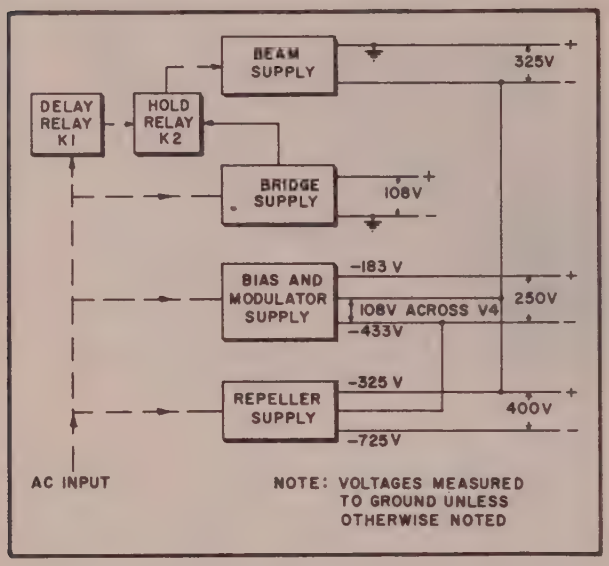


Figure 4—6. Block Diagram, Power Supplies

4—32. BEAM SUPPLY. The beam power supply (fig. 4—7) is the source of potential between the cathode and the grounded interaction grids of the reflex klystron. Rectification is accomplished by means of a single 5Y3WGT-A full-wave rectifier tube (V15). V16, a type 6098/CT tube serves as a series regulator. Excellent regulation of the voltage output is obtained by feedback through V17, a type 6AU6 single triode used as a voltage control and two type 5651 voltage regulator tubes (V18 and V19) connected in series for voltage reference. Control grid voltage for V17 is obtained from the power supply through the —325 V ADJ potentiometer R83, part of the power supply bleeder. The potentiometer is a screwdriver adjust-

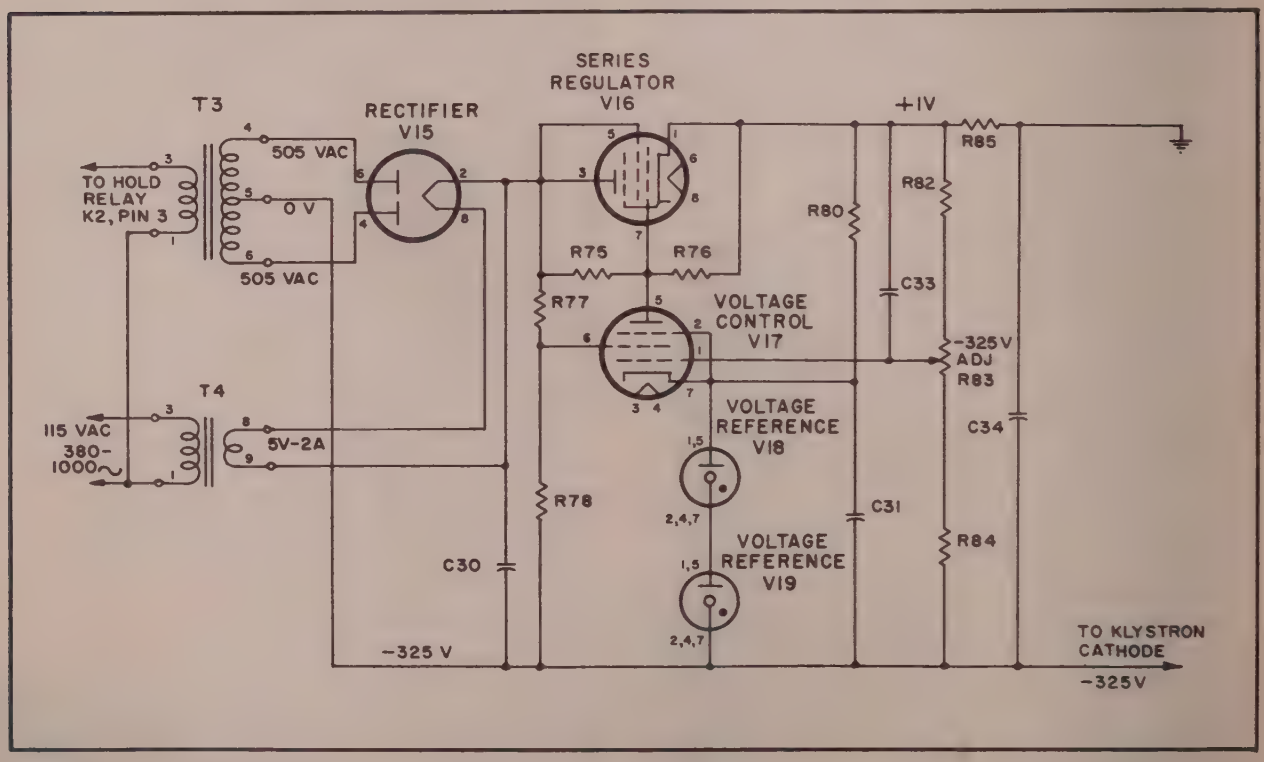


Figure 4—7. Beam Supply, Simplified Schematic

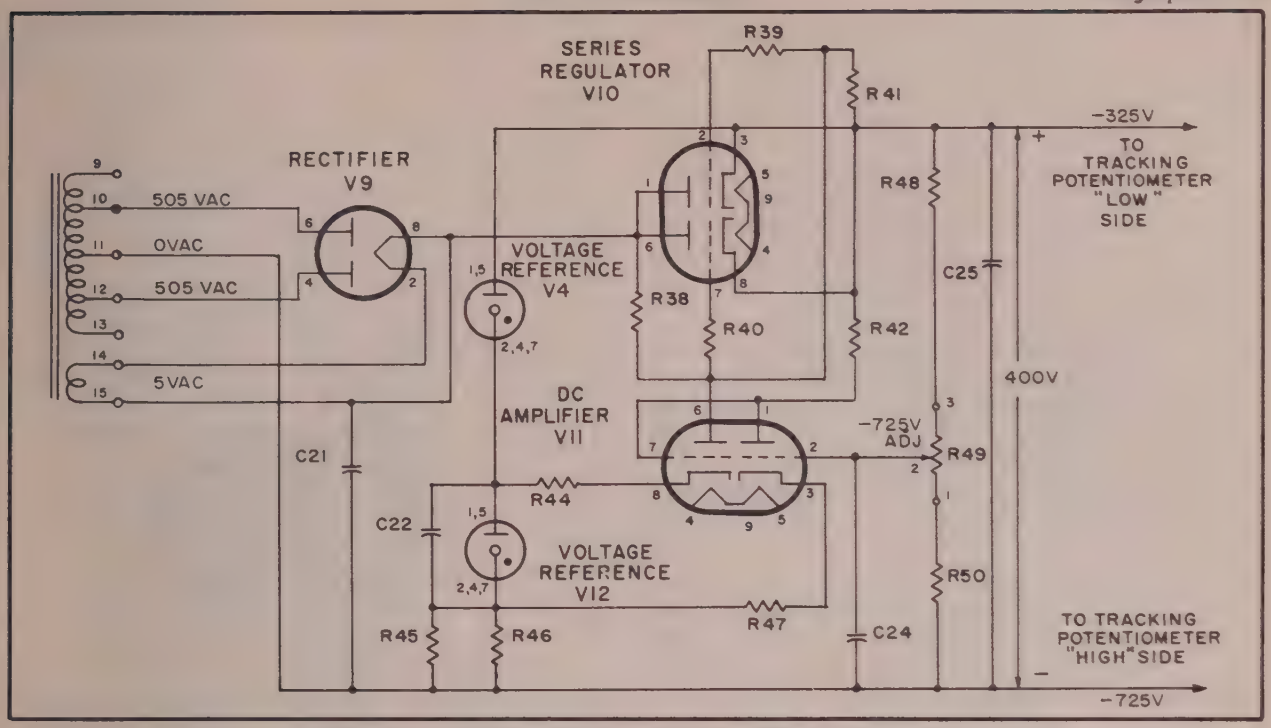


Figure 4—8. Repeller Supply, Simplified Schematic

ment which permits the voltage output of the power supply to be set to the required level. The voltage regulation obtained makes the output voltage independent of a-c supply fluctuations (± 10%) and load changes.

4—33. REPELLER SUPPLY. The function of the repeller supply (fig. 4—8) is to furnish a repeller voltage which is always negative with respect to the klystron cathode. The circuit consists of V9, a 5R4WGY full-wave rectifier, V10, a 12AT7 used as a series regulator, V11, two halves of a 12AT7 serving as d-c amplifier and voltage control, and voltage reference tubes V4 and V12, types OB2 and 5651, respectively. Potentiometer R49, part of the bleeder, is used to adjust the V11 grid voltage to obtain the required output supply voltage.

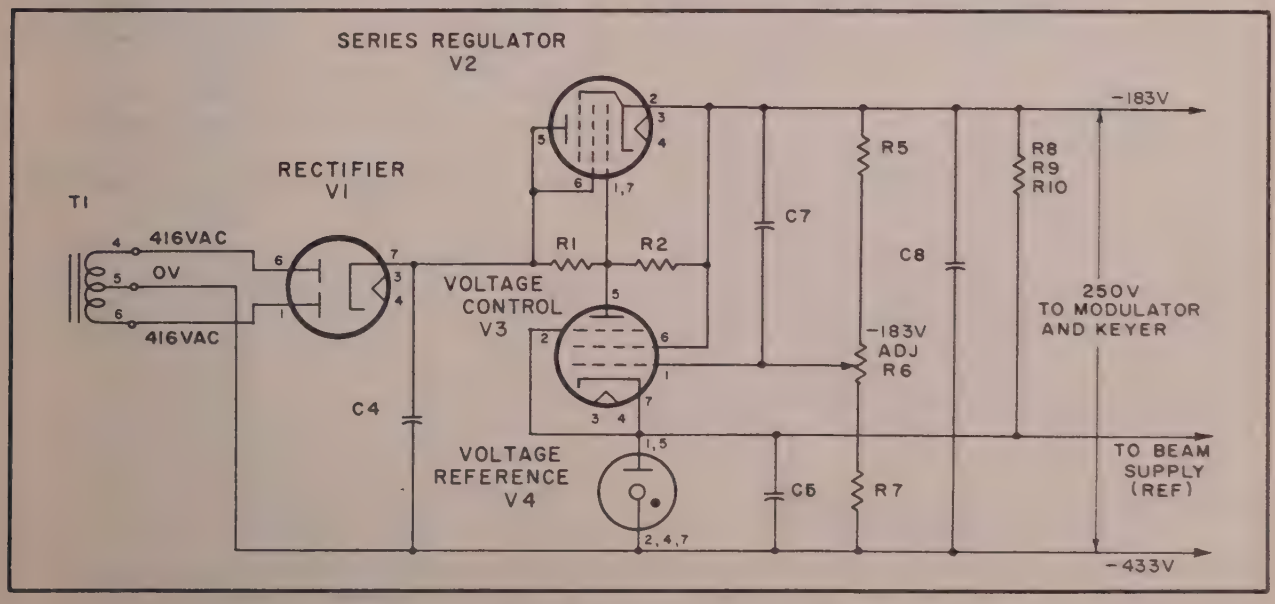


Figure 4—9. Bias and Modulator Supply, Simplified Schematic

4—34. BIAS AND MODULATOR SUPPLY. The function of the bias and modulator supply (fig. 4—9) is to furnish operating potentials for the modulator circuit and a bias voltage for the klystron control grid. Rectification is accomplished by V1, a 6X4W full-wave rectifier. Tube V2, a 6005/6AQ5W serves as a series regulator, while V3, a 6AU6 is used as a voltage control tube. Tube V4, an OB2 voltage regulator, is used as a voltage reference. The plate of V4 is connected to the negative output of the beam supply. Refer to the block diagram for the supply voltages.

4—35. BRIDGE CIRCUIT POWER SUPPLY. The function of the bridge circuit supply is to furnish a constant 108 volts positive potential which is used to balance the bridge circuit. (See figure 7—4.) Rectification is accomplished by V13, a type 6X4W full-wave rectifier while V14, a type OB2 voltage regulator, maintains a constant output voltage regardless of input power fluctuations (± 10%) and load changes.

4—36. FILAMENT SUPPLY. (See figure 7—4.) The filament voltages of all the tubes are obtained from various secondary windings of transformers T1 and T4. The primary windings of T1 and T4 are energized through switch S1 which is fused on both sides of the line by fuses F1 and F2.

4—37. PROTECTIVE RELAYS.

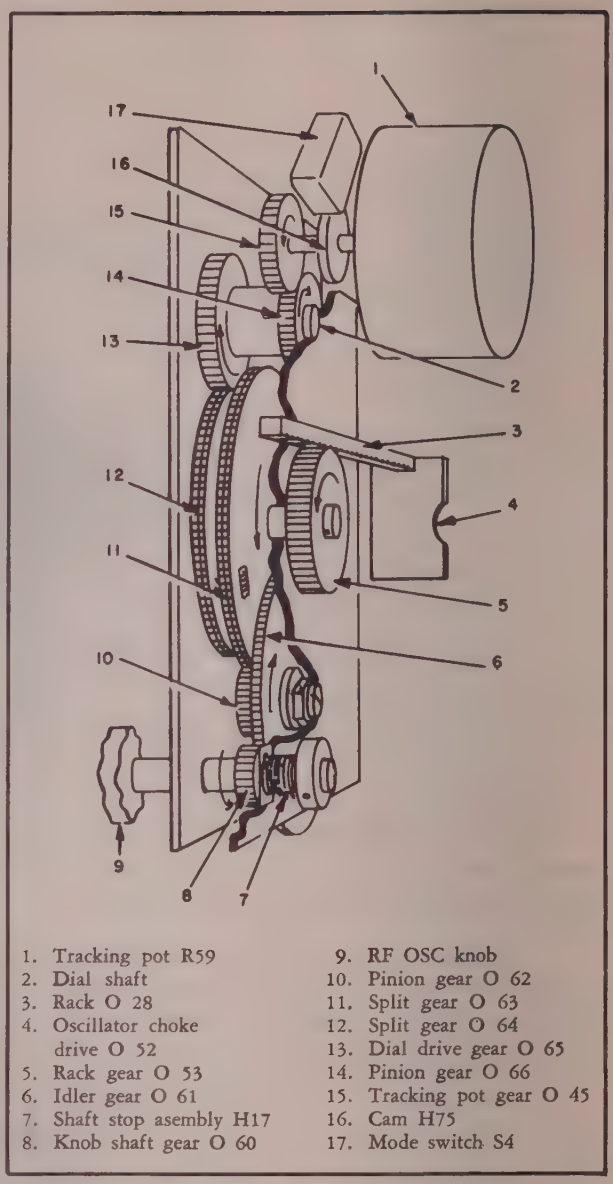
4—38. When switch S1 is closed, ac is applied to all circuits except the beam power supply. In order to protect the klystron tube a thermal time delay relay, K1, is energized through the normally closed circuit (primary) contacts of hold relay K2. After a delay of 75 seconds, contacts 4 and 8 of relay K1 close. Thus dc, tapped from the bridge circuit supply, passes through solenoid coil of hold relay K2 and the normally open circuit (secondary) contacts close and apply ac to the beam plate transformer (T3). By means of the flip-flop action of the hold relay contacts and circuit wiring, delay relay K1 is deenergized while hold relay coil remains energized until power is turned off.

4—39. ANTENNA.

4—40. The antenna consists of a partial waveguide short circuited at one end, ¼ of the median wavelength from the point at which the coax cable enters the waveguide. The cavity is excited by means of a tapered brass cone serving as a coax-to-waveguide impedance-matching device and as a radiator. The cone serves to match the 50-ohm characteristic impedance of the coaxial cable and the 300-ohm characteristic impedance of the waveguide over the broad bandwidth required by the 2:1 frequency range of the signal generator. The antenna is horizontally polarized when the signal generator is upright and vertically polarized when it is on its side.

4—41. DETAILED FUNCTIONAL OPERATION OF MECHANICAL COMPONENTS.

4—42. GENERAL. The principal mechanical components are the oscillator gear box assembly and the thermistor and attenuator drive assembly.



1. Tracking pot R59
2. Dial shaft
3. Rack O 28
4. Oscillator choke drive O 52
5. Rack gear O 53
6. Idler gear O 61
7. Shaft stop asembly H17
8. Knob shaft gear O 60
9. RF OSC knob
10. Pinion gear O 62
11. Split gear O 63
12. Split gear O 64
13. Dial drive gear O 65
14. Pinion gear O 66
15. Tracking pot gear O 45
16. Cam H75
17. Mode switch S4

Figure 4—10. Oscillator Gear Box Assembly

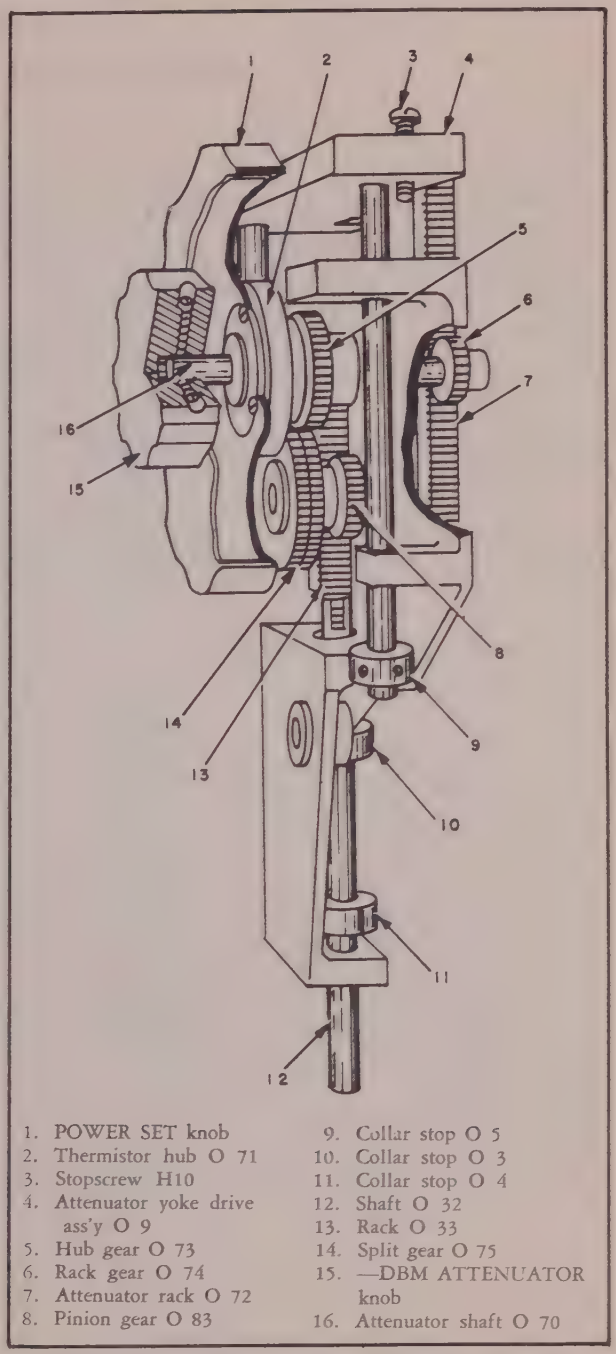
4—43. OSCILLATOR GEAR BOX ASSEMBLY. The function of the oscillator gear box assembly (fig. 4—10) is to provide single knob control of the oscillator choke drive, the tracking potentiometer, and the frequency dial. The RF OSC knob (9) is mounted on the knob shaft on which are mounted knob shaft gear O 60 (8) and shaft stop assembly H17 (7). The knob shaft gear drives idler gear O 61 (6) whose output pinion O 62 (10) drives split gear O 63 (11). Since rack gear O 53 (5), split gear O 64 (12) and split gear O 63 are attached to a common shaft, movement of the latter gear drives the former two gears. Hence, oscillator rack gear (5) drives spring-loaded rack O 28 (3) which is attached to oscillator choke drive O 52 (4); and split gear O 64 (12) drives dial gear O 65 (13)

which is mounted on the dial shaft and thus rotates the dial. Pinion gear O 66 (14), mounted on the dial shaft, drives tracking potentiometer gear O 45 (15), mounted on the tracking potentiometer shaft, and thus varies the tapped resistance of potentiometer R59. Mode switching is accomplished by means of cam H75 (16) and mode switch S4 (17). Relative motion of the gears are shown in figure 4—10 by arrows. The RF OSC knob is being turned in a clockwise direction.

4—44. THERMISTOR AND ATTENUATOR DRIVE ASSEMBLY. The function of the thermistor and attenuator drive assembly is to move the thermistor and attenuator probes inside the waveguides. Both assemblies are mounted on a common casting. Refer to figure 4—11.

4—45. Movement of the thermistor drive assembly is controlled by the POWER SET knob (1) which is attached to thermistor hub O 71 (2) and hub gear O 73 (5). Hence, rotation of the POWER SET knob turns spring-loaded split gear O 75 (14) and pinion gear O 83 (8). Pinion gear O 83 drives rack O 33 (13). Pinned to the rack O 33 is shaft O 32 (12). The thermistor probe assembly, CP1, is mounted on the thermistor yoke assembly O 7. (See figures 5—2 and 5—3.) Thermistor yoke assembly, attached to shaft O 32, thus positions the thermistor probe assembly within its waveguide-beyond-cutoff tube. Upper and lower limits of probe insertion are adjusted by means of collar stops O 3 (10) and O 4 (11), respectively.

4—46. Movement of the attenuator drive assembly is controlled by the —DBM ATTENUATOR knob (15). The knob is attached to attenuator shaft O 70 (16). This shaft passes through the center of thermistor hub O 71. Since attenuator rack gear O 74 (6) is mounted on shaft O 70, and engages with attenuator rack O 72 (7), any rotation of the —DBM ATTENUATOR knob effects a corresponding vertical displacement of the attenuator yoke drive assembly O 9 (4). The attenuator probe assembly AT1 is mounted on the yoke drive assembly which positions the probe within its wave-guide-beyond-cutoff tube. The upper limit of probe insertion is adjusted by collar stop O 5 (9) while stop-screw H10 (3) adjusts the lower limit.



1. POWER SET knob
2. Thermistor hub O 71
3. Stopscrew H10
4. Attenuator yoke drive ass'y O 9
5. Hub gear O 73
6. Rack gear O 74
7. Attenuator rack O 72
8. Pinion gear O 83
9. Collar stop O 5
10. Collar stop O 3
11. Collar stop O 4
12. Shaft O 32
13. Rack O 33
14. Split gear O 75
15. —DBM ATTENUATOR knob
16. Attenuator shaft O 70

Figure 4—11. Attenuator Drive Assembly

SECTION V

ORGANIZATIONAL MAINTENANCE

5—1. SCOPE.

5—2. This section discusses maintenance which may be performed on the signal generator at the organizational level. Trouble analysis to locate the source of substandard performance, and repair and adjustment procedures that are required to restore the equipment to performance standards are described.

5—3. MINIMUM PERFORMANCE STANDARDS FOR ORGANIZATIONAL MAINTENANCE.

5—4. Minimum peformance standards for organizational maintenance and methods of checking them are given in table VI.

5—5. PRELIMINARY INSPECTION.

5—6. GENERAL. Preliminary inspection is a series of operations performed on the signal generator, while it is turned off, in an effort to correct conditions which might lead to a breakdown. In general these breakdowns may be caused by overheating of electrical components, the accumulation of dust and dirt on parts, and loose connections and fittings. Inspection should be carried out with a view toward finding evidences of these conditions. Table VII lists the preliminary inspection procedures.

WARNING

THE OPERATION OF THIS EQUIPMENT INVOLVES THE USE OF HIGH VOLTAGES, WHICH ARE DANGEROUS TO LIFE. REMOVE THE POWER BY DISCONNECTING THE POWER CORD W101 FROM POWER INPUT RECEPTACLE J1 BEFORE STARTING INSPECTION.

5—7. REMOVAL OF PANEL AND CHASSIS ASSEMBLY FROM CASE. To remove the panel and chassis assembly from the case, proceed as follows:

a. Loosen the camlock screws which secure the antenna to the rear of the case by a one-half turn counterclockwise.

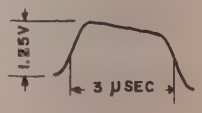
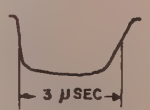
b. Unscrew the four shaft and stud assemblies on the front of the panel (fig. 5—1).

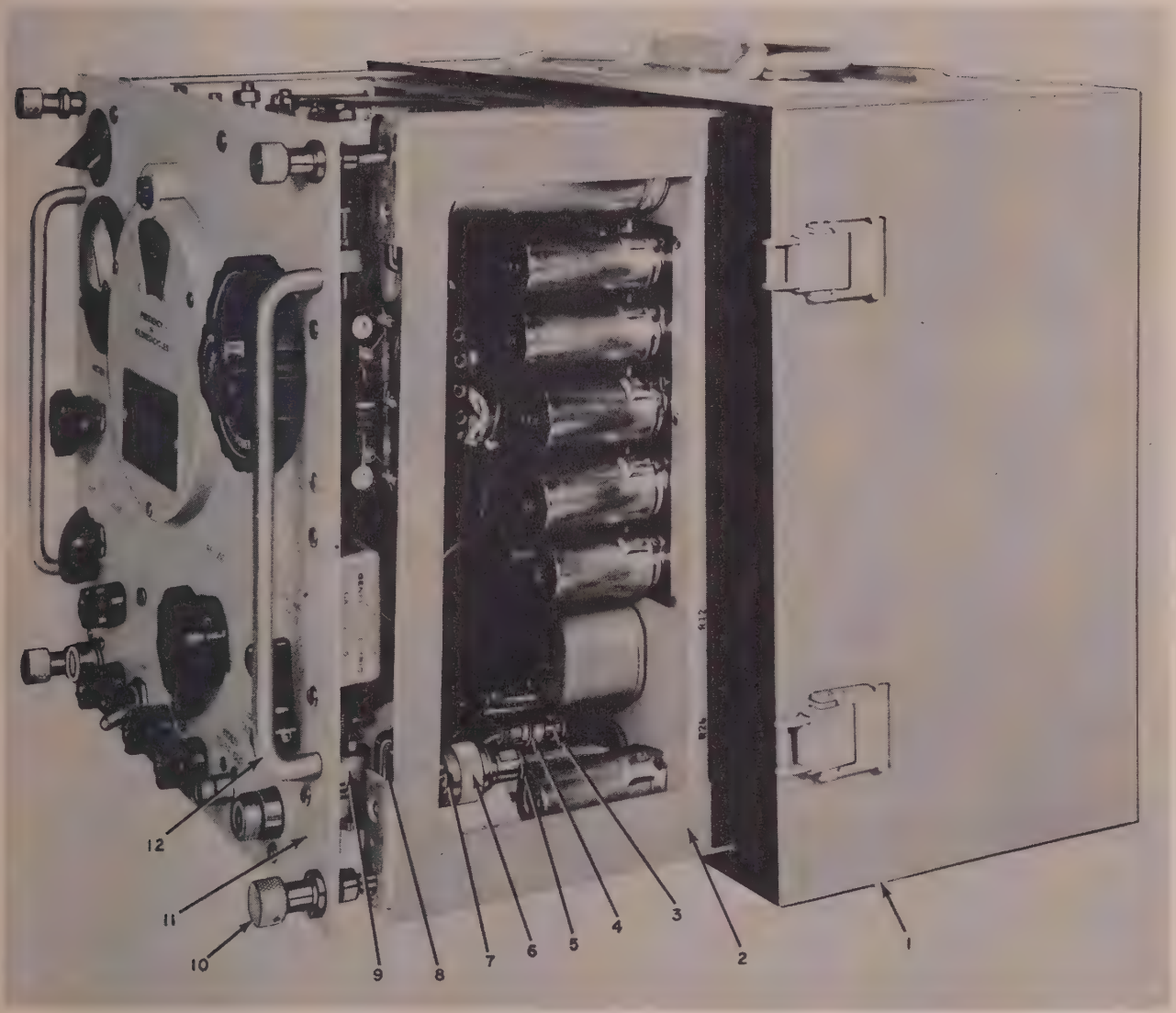
c. Grasp the handles on the panel and pull the assembly out of the case.

Note

For convenience, the case may be placed on its back and the panel and chassis assembly lifted up and out of the case.

TABLE VI. MINIMUM PERFORMANCE STANDARDS FOR ORGANIZATIONAL MAINTENANCE

Operational Characteristic	*Test*	*Minimum Standard*
Unmodulated r-f output indication	Power ON. Set Function Switch S2 to OFF. Adjust METER ZERO for zero deflection on meter. Set Function Switch S2 to CW. Adjust the POWER SET control until the meter pointer deflects to CAL. Set ATTENUATOR (—DBM) dial at "O." One milliwatt of output ± 3db is indicated.	1 mw
Pulse indication 1. Video	1. Adjust as above. Set Function Switch S2 to PULSE position. Connect radar indicator to VIDEO PULSE OUT Receptacle J4.	
2. RF	2. Connect radar receiver to DIRECT RF OUTPUT Receptacle J2 and check frequency spectrum over entire band.	



1. Case
2. Chassis
3. Connector, receptacle J10
4. Connector, plug P10
5. Hex nut H12
6. Connector, plug P3
7. Output Switch, receptacle J3
8. Snapslide fastener
9. Output Switch S3
10. Shaft and stud assembly
11. Panel
12. Handle

Figure 5—1. Panel and Chassis Assembly

5—8. REMOVAL OF PANEL FROM CHASSIS. To separate the panel from the chassis, proceed as follows:

a. Unscrew antenna connector P3 from Output Switch Receptacle J3.

b. Pull the four snapslide fasteners away from the corners to release the shaft and stud assemblies.

c. Pull out the four shaft and stud assemblies.

d. Pull the panel slightly from the chassis and disconnect the panel cable plugs from the chassis cable receptacles.

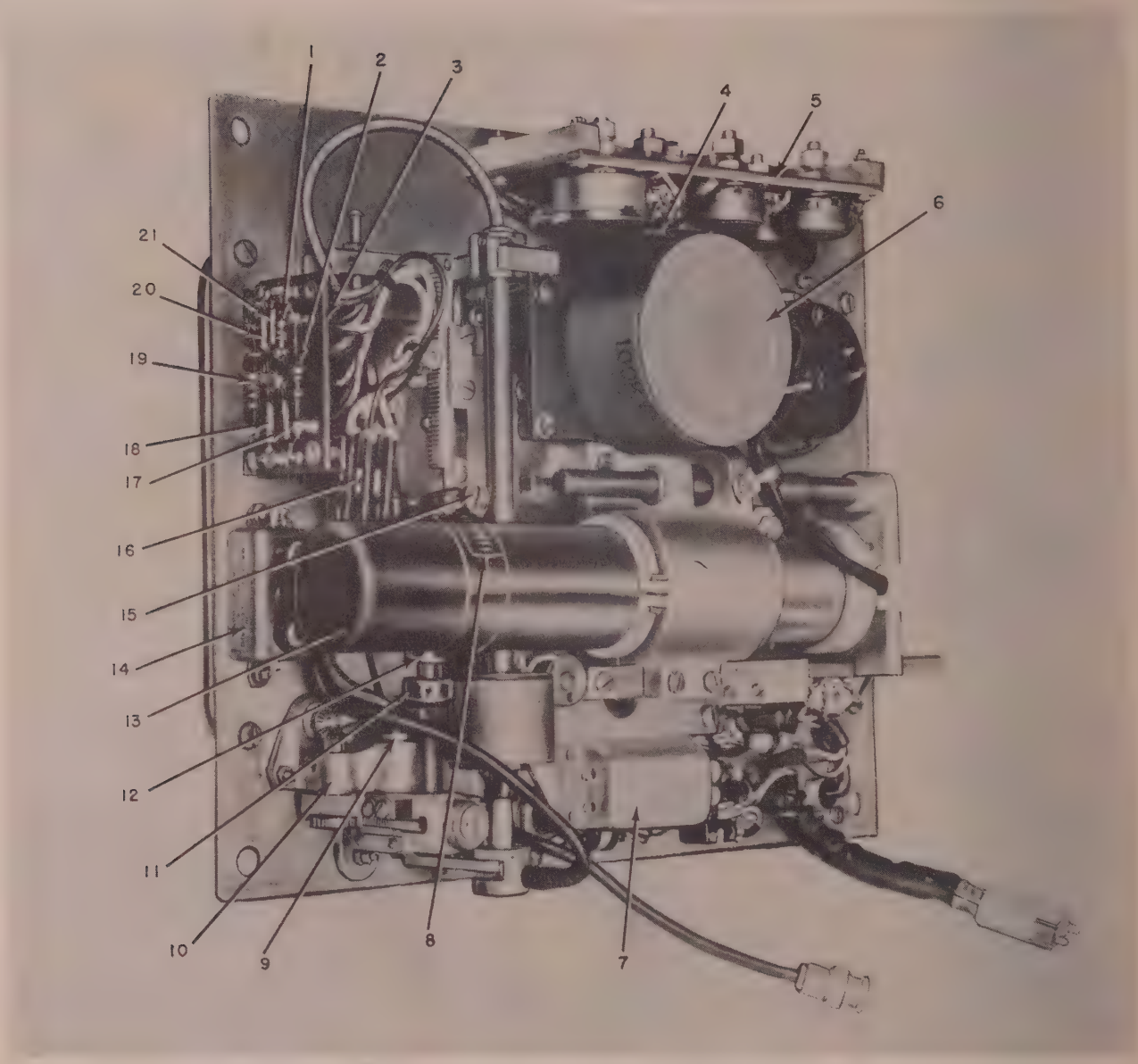
e. The panel is now completely free from the chassis.

TABLE VII. PRELIMINARY INSPECTION PROCEDURE

What To Inspect	*Defects To Look For*	*Remedies*	*Precautions*
Power cord, video cable and r-f cable	Kinks in the cable, cuts, deteriorations and fraying of the rubber insulation.	Replace the cable if necessary.	
	Loose connectors.	Resolder connections or replace cable.	
	Dirt, oil, grease corrosion.	Clean with a cloth. Moisten cloth with cleaning solvent if necessary.	
Case and front of panel	Holes in case or cover.	Replace the case or cover, if necessary.	
	Dirt and corrosion. Screens inside the panel and case, dirty or corroded.	Clean with approved cleaning agent.	
Meter M1	Bent indicator, cracked or broken glass in meter M1.	Replace the meter.	Meter M1 is hermetically sealed. If glass is cracked replace the meter as soon as a replacement is available.
FREQUENCY IN KILO-MEGACYCLES dial window	Cracked or broken dial window.	Replace the window or the dial cover assembly. If the glass is cracked, a temporary repair may be made with scotch tape.	
Knobs, screws, connectors, handles	Looseness.	Tighten.	Tighten carefully. Screws tightened beyond the pressure for which they are designed can be damaged or broken.
Mounting of switches S1, S2, and S3	Looseness.	Tighten mounting screws and nuts.	
Switches S1 and S3	Inability to change position.	If defective S1 and S3 must be replaced.	
Shaft LOCK	Failure to hold frequency dial fixed.	Tighten the setscrew holding the knob. If lock still fails to hold send signal generator to Field Maintenance.	
Fuses	Dirty fuse caps. Empty spare fuse holders on front of panel.	Clean with a cloth. Insert 3 amp. 250 v fuse.	
Rear of panel and chassis	Dirt, corrosion, moisture, rust.	Remove loose dirt and dust with a brush or low air pressure. Remove dirt and grease on the chassis or panel with a brush or cloth dipped in cleaning solvent.	
Mounting screws and clamps	Looseness.	Tighten.	Do NOT touch slotted shafts of variable resistors.
Wiring	Loose wires.	Resolder, recable or replace under clamps as necessary.	
	Frayed worn or missing insulation.	Rewire.	
Solder joints	Loose or cold solder joints.	Resolder.	
	Corroded joints.	Clean and resolder.	
Resistor, capacitor and tube mounting boards	Loose mounting.	Tighten mounting screws and nuts.	
Resistors	Cracks, chipping, blistering, discolorations and other signs of overheating.	Replace resistor.	
Capacitors	Leaks, bulges, signs of discoloration.	Replace capacitor.	
	Loose mounting bracket.	Tighten nuts holding bracket.	

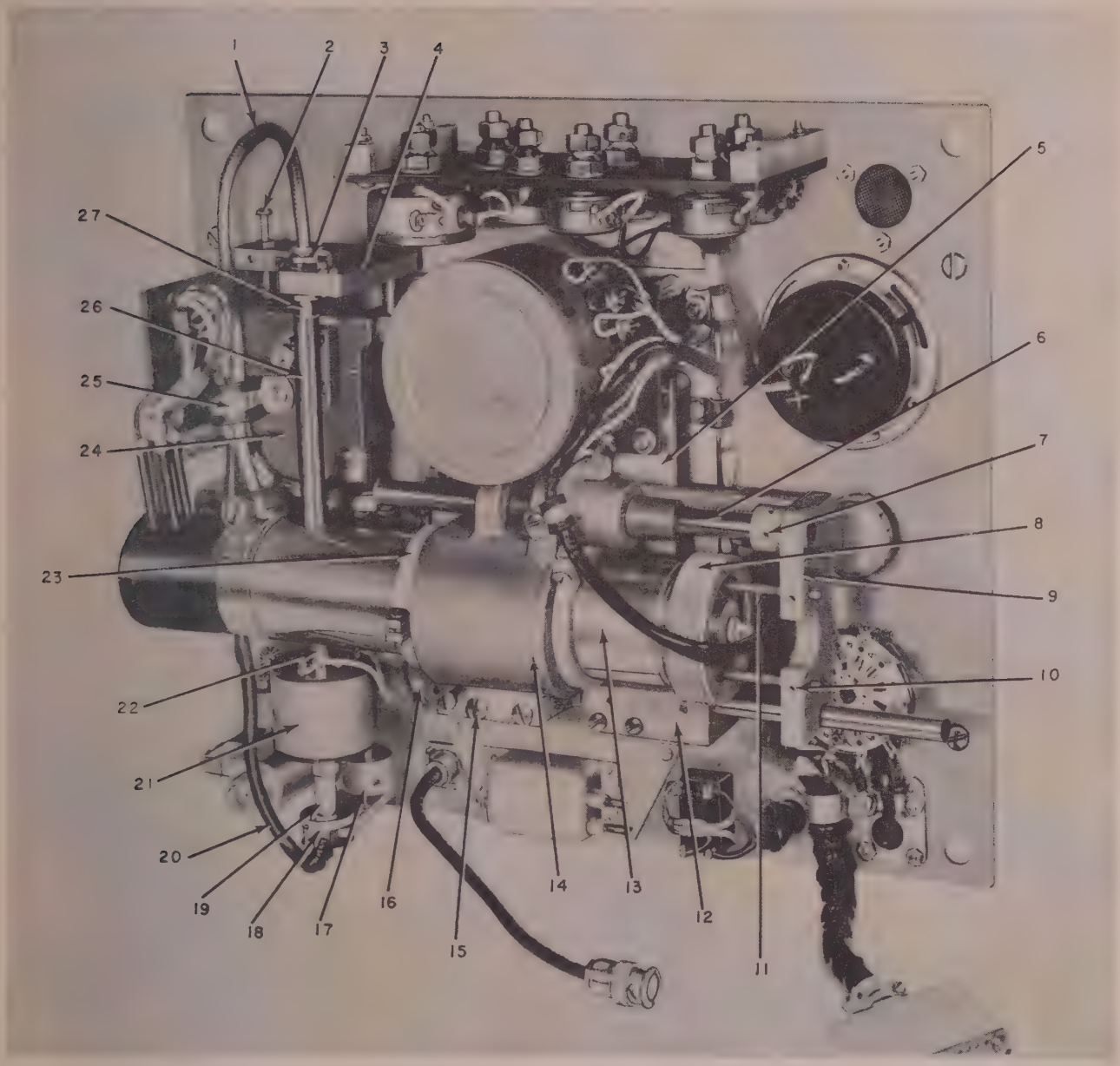
TABLE VII. PRELIMINARY INSPECTION PROCEDURE (continued)

What To Inspect	*Defects To Look For*	*Remedies*	*Precautions*
Wafer switch S2	Bent contacts. Broken contacts. Dirty or corroded contacts.	Re-bend with tweezers. Replace contacts or the entire switch. Clean with cloth moistened with carbon tetrachloride.	
Tubes, except reflex klystron	Poor seating.	Press tubes firmly into sockets.	Never work on tubes immediately after shutdown. Severe burns may result. Do not jiggle tubes, or partially withdraw them from sockets. Such movements tend to weaken tube pins and to spread the contacts in the sockets. Do NOT check the reflex klystron tube.
Tube shields except for reflex klystron Tube sockets	Looseness. Missing shields. Looseness. Cracks, chips.	Press into position. Replace. Tighten mounting screws. Replace socket if necessary.	
Attenuator cable W2 Antenna cable W3 Thermistor cable W4 The repeller lead Video cable W1	Loose terminals, broken conductors conductors, frayed, cut or broken installations.	If cables W2, W3, W4, or the repeller lead are defective, send the signal generator to Field Maintenance for repair. The antenna and attenuator terminals at Output Switch S3 may be tightened. The antenna assembly may be replaced. Refer to paragraphs 5-20 and 5-21. The cable to the VIDEO PULSE OUT receptacle may be replaced if defective.	Take care not to loosen the attenuator connection at Output Switch S3 as the contact spring may fall out. Do NOT attempt replacement of cables W2, W3, W4, or the repeller lead. Recalibration of signal generator will be necessary.
Oscillator Drive	Catching or jamming when the RF OSC control knob is rotated. Dust, dirt and foreign matter in oscillator gear box O 1 or on oscillator drive shaft O 2. Bent or broken gears or gear teeth.	Clean. Remove any foreign matter. Send signal generator to Field Maintenance for repair.	Release the knob lock by turning counterclockwise. CAUTION Do NOT move the drive in any way other than by its control knob. Do not interfere in any way with the operation of the gear mechanism while the control is being turned. Never use force.
Thermistor and attenuator drive assembly	Catching or jamming when either the ATTENUATOR or POWER SET control knobs are turned. Dust, dirt and foreign matter. Loose setscrews in the three collar stops O 3, O 4, and O 5. Loose collar stop or loose stop-screw H10 in attenuator yoke assembly.	Remove with a brush or cloth dipped in carbon tectrocloride. If only one of the two setscrews in a collar stop is loose, tighten it. If both setscrews in a collar stop are loose, reset the collar stop. Refer to paragraphs 6—59 through 6—62.	CAUTION Refer to caution for Oscillator Drive above. CAUTION Collar stop O 3 limits the travel of the thermistor. The 8-32 screw H10 limits the travel of the attenuator. If these are not properly set, the thermistor probe tip, the attenuator probe tip or the klystron tube may be damaged.
Switch S4	No click as the FREQUENCY IN KILOMEGACYCLES dial is rotated between 1.2 and 1.4 kmc.	Send to Field Maintenance for repair.	



1. Resistor R70
2. Resistor R65
3. Terminal board TB8
4. Resistor R37
5. Terminal board TB7
6. Tracking potentiometer R59
7. Filter FL1
8. Clamp H13
9. Hex nut H12
10. Output switch S3
11. Collar stop O 4
12. Collar stop O 3
13. Klystron tube cover E7
14. Capacitor C19
15. Clamp screw H80
16. Collar stop O 5
17. Resistor R68
18. Resistor R69
19. Resistor R67
20. Resistor R73
21. Resistor R71

Figure 5–2. Panel, Rear Oblique View No. 1



1. Attenuator cable W2
2. Stop screw H10
3. Attenuator coupling O 12
4. Attenuator yoke assembly O 9
5. Gear box O 1
6. Guide rod O 2
7. Setscrew H82
8. Barrel locknut H45
9. Oscillator drive asembly O 52
10. Setscrew H41
11. Choke pushrod O 11
12. Block bearing O 80
13. Oscillator barrel Z1
14. Barrel support A6
15. Binding head screw H43
16. Stop washer collar H18
17. Thermistor yoke assembly O 7
18. Thermistor cable junction box W4
19. Thermistor probe AT2
20. Thermistor probe assembly CP1
21. Thermistor disc mount assembly CP2
22. Thermistor barrel W6
23. Barrel c-clamp H84
24. Thermistor and attenuator drive support O 8
25. Cable clamp H15
26. Attenuator barrel W5
27. Attenuator probe AT1

Figure 5—3. Panel, Rear Oblique View No. 2

TABLE VIII. TROUBLE ANALYSIS PROCEDURE FOR ORGANIZATIONAL MAINTENANCE

(Measurements made from test point to ground ③ unless otherwise noted. When two test points are indicated the first one is the negative side of meter.)

Step	*Test Point*	*Test Equipment*	*Control Settings and Instructions*	*Normal Indication*	*If Indication is Normal*	*If Indication is Abnormal*
1 Part I	Visual and aural	None	Power turned ON.	Dial light and tubes light. Blower motor operates.	Proceed with step 2.	Check dial light, fuses F1 and F2. Proceed with part II.
Part II	Power source	A-c voltmeter		115 V.	Proceed with part III.	Trouble is in a-c power source.
Part III	Ends of Power Cable CX-2470/U	Ohmmeter	Cable removed from both signal generator and power source.	Continuity from end to end, each lead. Infinite resistance at either end between leads.	Proceed with part IV.	Open or shorted Power Cable CX-2470/U.
Part IV	Across connector J1.	Ohmmeter	Power cable disconnected from generator.	2 ohms	Proceed with step 2.	Trouble is in POWER INPUT connector J1, the primaries of T1, T3, or T4, filter FL1, or blower motor B1.
2 Part I	VIDEO PULSE OUT receptacle J4	Radar Indicator input connected to receptacle J4, VIDEO PULSE OUT.	Function Switch S2 on PULSE.	Pulse on radar indicator.	Proceed with step 3.	Trouble may be in pulse generator. Refer to paragraph 5—14. If operation of pulse generator is normal, proceed with part II.
Part II	Same as part I	Ohmmeter	Power OFF.	84 ohms	Proceed with step 3.	Trouble may be defective R13 or T2 tertiary terminals 1 and 7, or connector J4.
3 Part I	None	None	Power turned ON. Function Switch S2 on OFF.	Meter M1 can be zero set by METER ZERO control.	Proceed with step 4.	Trouble may be in either the bridge circuit or the bridge circuit supply. Proceed with part II.
Part II	⑤	D-c voltmeter	Same as part I of this step.	+ 108 volts	Trouble is in bridge circuit. Refer to paragraph 5—15.	Trouble is in the bridge circuit power supply. Refer to paragraph 5—11.
4 Part I	None	None	Power ON. Function Switch S2 on CW. Wait approximately one minute.	Meter pointer can be set to CAL by POWER SET control.	Proceed with step 5.	Trouble may be in the beam supply, the relay circuit, the repeller supply or incorrect beam current. Proceed with part II.
Part II	⑩	D-c voltmeter	Same as part I of this step.	— 325 volts	Proceed with part VIII.	Trouble is in either the beam supply or the relay circuit. Proceed with part III.
Part III	Terminal 1 of T3 to terminal 3 of T3.	A-c voltmeter	Same as part I of this step.	115 volts	Trouble is in beam supply. Refer to paragraph 5—11.	Trouble is in the relay circuit. Refer to part IV.

	Part IV	Pin 4 of K1	D-c voltmeter	Power turned ON. Same as part I of this step.	103 volts	Proceed with part VII.	No voltage indicates trouble with resistors R61 and R62. A reading of + 200 volts indicates trouble in delay relay K1 or K2. Proceed with part V.
	Part V	Pin 8 of K2	Ohmmeter	Power turned OFF.	10,000 ohms	Proceed with part VI.	Trouble in hold relay coil K2.
	Part VI	Pin 8 of K2	Same as part I of this step.	Same as part I of this step.	103 volts	Proceed with part VII.	Delay relay K1 is defective.
	Part VII	Terminal 1 of T3 to terminal 3 of K2	A-c voltmeter	Same as part I of this step.	115 volts	Relay circuit is operating properly. Proceed with part VIII.	Hold relay is defective..
	Part VIII	(1) to (10)	D-c voltmeter	Same as part I of this step.	— 400 volts	Proceed with part IX.	Trouble is in repeller supply. Refer to paragraph 5—11.
	Part IX	(10) to (8)	D-c voltmeter	Power turned on. Same as part I of this step. Adjust BEAM CURRENT ADJ R26 to give 10 volts on meter.	+ 10 volts	Proceed with step 5.	Bias voltage for klystron V7 incorrect. Trouble may be in the bias and modulator supply or the keyer. Refer to part X.
	Part X	(11) to (7)	D-c voltmeter	Same as part I of this step.	+ 250 volts	Proceed with part XI.	Trouble is in the bias and modulator supply. Refer to paragraph 5—11.
	Part XI	(11) to (8)	D-c voltmeter	Same as part I of this step.	108 to 128 volts depending upon the setting of R26.	Trouble is in klystron circuit. Send signal generator to Field Maintenance for repair.	Trouble is in the keyer stage. Refer to paragraph 5—13.
5	Part I	DIRECT RF OUTPUT receptacle J4	Receiver of radar system	Power turned ON. Switch S2 on PULSE. Output switch S3 on DIRECT RF OUTPUT. RF Cable CG-92B/U (W102) connected to radar receiver. Signal generator adjusted for proper operation.	Signal is seen on radar indicator screen.	Signal generator is operating properly when directly connected.	If no signal is received, the trouble may be in the Output Switch S3, the attenuator assembly, or the pulse shaper. Proceed with part II.
	Part II	(11) to (B)	D-c voltmeter	Same as part I of this step.	92 volts (See figure 7—1)	Send signal generator to Field Maintenance for repair.	Trouble is in pulse shaper V5B. Refer to paragraph 5—13.
6	Part I	None	Radar receiver	Power turned ON. Function Switch S2 on PULSE. Output Switch S3 on ANTENNA OUTPUT.	Signal observed.	Signal generator is operating properly.	If no signal is received, the trouble may be in Output Switch S3 or the antenna assembly. Proceed with part II.
	Part II	Antenna connection P3 to (D) Antenna	Ohmmeter	Power turned OFF. Connector P3 removed from connector J3.	Zero resistance.	Trouble is in Output Switch S3. Send signal generator to Field Maintenance for repair.	Trouble is in the antenna assembly. Replace the antenna assembly. Refer to paragraph 5—20 and 5—21.

WARNING

THE OPERATION OF THIS EQUIPMENT INVOLVES THE USE OF HIGH VOLTAGES DANGEROUS TO LIFE. THE —400 VOLTS OUTPUT OF THE REPELLER SUPPLY AND THE —250 VOLTS OUTPUT OF THE BIAS AND MODULATOR SUPPLY REPRESENT —725 AND —433 VOLTS RESPECTIVELY TO CHASSIS GROUND. ALTHOUGH BLEEDER CIRCUITS ARE USED TO PREVENT CAPACITORS FROM RETAINING CHARGES AFTER THE POWER HAS BEEN DISCONNECTED, ALWAYS DISCHARGE AND GROUND CIRCUITS BEFORE TOUCHING THEM TO AVOID INJURY. OBSERVE ALL SAFETY PRECAUTIONS.

5—9. TROUBLE ANALYSIS FOR ORGANIZATIONAL MAINTENANCE.

5—10. GENERAL. Failure to meet a minimum performance standard given in table VII will require an analysis of the possible causes of such failure. An understanding of the theory of operation of the signal generator as given in section IV of this handbook will be helpful in analyzing trouble to find the probable cause. Table VIII, Trouble Analysis For Organizational Maintenance lists a step-by-step procedure by which the cause of trouble may be traced to the pulse generator, the pulse shaper, the keyer or to one of the power supplies, i.e., table VIII will be helpful in locating a defective stage. A defect within a stage may be located by voltage and resistance measurements. Use clip leads at the ends of voltmeter test prods for all voltage checks except at test socket J5. Be sure to turn equipment power OFF when attaching the test prod leads to circuit components. Make sure all cable plugs are properly connected. After secure connections have been made, apply operating power to the signal generator under test and wait for the 75-second delay cycle to be completed. Turn power OFF before removing test prods from circuit components. Figures 7—1 and 7—2 give the normal voltages and resistances at the tube socket terminals and may serve to isolate the defective part. Figures 5—2 through 5—7 will be helpful in locating a part for replacement or adjustment.

5—11. CHECKING THE D-C POWER SUPPLIES.

5—12. GENERAL. The d-c voltages are obtained from four regulated power supplies, the beam supply, the bias and modulator supply, the repeller supply and the bridge circuit supply. Refer to section IV for a detailed discussion and to figure 7—4 for the over-all schematic diagram. In the event a power supply does not give the normal indication called for in Table IX, Power Supply Voltages, refer to table XI and to figures 7—1 and 7—2 to locate the defective component in the power supply.

TABLE IX. POWER SUPPLY VOLTAGES

Power Supply	*J5 Test Points*		*Voltage*
	From	*To*	
Beam	10	3	—325
Bias and Modulator	11*	7*	+250
	7	3	—183
	11	3	—433
Repeller Supply	1*	10*	+400
	1	3	—725
Bridge circuit	3	5	+108

* Preferred test points.

5—13. CHECKING THE MODULATOR SECTION.

5—14. The modulator section comprises the pulse generator, pulse shaper and the keyer stages. Check the voltages at these stages for each of the three positions of Function Switch S2. Table X, Modulator Voltages, gives the normal voltages at the tube terminals for the three positions of the function switch. Refer to figure 7—4 for the over-all schematic diagram and to figures 5—2 through 5—7 for location of components and test points.

5—15. CHECKING THE BRIDGE CIRCUIT.

5—16. Set power ON and Function Switch S2 at OFF. Turn the METER ZERO control until meter pointer is at zero. If the meter will not zero, proceed as follows:

CAUTION

If the meter pointer goes off scale, thermistor RT1 is defective. Send the unit to Field Maintenance for repair.

a. Refer to step 3, part II of table VIII and check the bridge circuit supply voltage. If satisfactory, proceed with step b. below.

b. Check METER ZERO control R64, and resistors R68, R69, R70, R71 and R73. Refer to figure 7—4 for resistance values. Check meter M1 for an open circuit.

c. Refer to table XI, item 6, and check COARSE ADJUSTMENT R63. If not satisfactory, proceed with step d. below.

d. If trouble has not been found by following above procedures, send the signal generator to Field Maintenance for repair.

5—17. REPAIR AND ADJUSTMENT FOR ORGANIZATIONAL MAINTENANCE.

5—18. ACCESS TO PARTS FOR REPAIR. Dial lamp I 1 and fuses F1 and F2 are on the front of the panel and are readily accessible. Tubes and other components may be reached by removal of the unit from the case (par. 5—7) and separate the panel from the chassis (par. 5—8).

5—19. REPLACING VACUUM TUBES. All tubes, except the reflex klystron, may be replaced by organizational maintenance units. These personnel are cautioned not to attempt replacement, since recalibration of the equipment by Field Maintenance will then be required. All other vacuum tubes are accessible after the panel and chassis have been removed from the case and separated from each other.

TABLE X. MODULATOR VOLTAGES

* No measurements necessary.

Step	Circuit	From	To	Voltage when Function Switch S2 is set in: OFF	PULSE	CW	If Indication is Abnormal
1 Part I	Pulse Generator V5A	(A) Plate, pin 1	(A1) Cathode, pin 3	*	250	*	Check the bias and modulator supply. Refer to paragraph 5-14. Check tube V5, resistors R15 and R17, primary of transformer T2, terminals 3 and 5, capacitors C17, C18, and selector switch S2.
Part II		Grid, pin 2	(A1) Cathode, pin 3	*	—15	*	Check the secondary of T2 terminals 2 and 6, capacitors C11, C12, C13, and resistor R12. Do NOT disturb the setting of R12.
2 Part I	Pulse Shaper V5B	(B) Plate, pin 6	(A1) Cathode, pin 8	90	90	*	Check tube V5, the seven resistors R18 through R24, the six resistors R26 to R31. DO NOT disturb the setting of R26.
Part II		Grid, pin 7	(A1) Cathode, pin 8	0	0	*	Check resistors R16 and R17, and capacitor C16.
3	Keyer V6	(8) Cathode, pin 8	(11)	90			Check tube V6. Refer to paragraph 5—22 and check the setting of BEAM CURRENT ADJ. R26. Check resistors R33 and R34.

TABLE XI. ADJUSTMENTS, POWER SUPPLIES

(See figures 6—8 and 6—9 for location of adjustment controls.)

Item	Circuit	Test Points	Test Equipment	Normal Indication	Adjustment Procedure
1	Beam Supply	(10) and (3)	D-c voltmeter	—325 volts	Adjust potentiometer R83. If not normal refer to paragraph 5—9.
2	Bias and Modulator Supply	(11) and (7)	D-c voltmeter	250 volts	Adjust potentiometer R6. If normal indication cannot be obtained, refer to paragraph 5—9.
3	Repeller Supply	(1) and (10)	D-c voltmeter	400 volts	Adjust potentiometer R49. If normal indication cannot be obtained, refer to paragraph 5—9.
4	Klystron bias	(10) and (8)	D-c voltmeter	+10 volts with Function Switch in CW position.	Adjust potentiometer R26. If normal indication cannot be obtained, refer to step 4, part IX of table VIII.
5	Bridge Supply	(3) and (5)	D-c voltmeter	108 volts	There is no adjustment for this supply. Its normal output is 108 volts. It is possible, however, to misadjust COARSE control R63 to lower the output. Refer to bridge circuit below.
6	Bridge circuit	None	None	Meter M1 can be set to ZERO with Function Switch S2 at OFF and power on.	Allow signal generator to remain off at least one hour. Turn set on and adjust METER ZERO control fully clockwise. Adjust COARSE ADJ. R64 until meter goes beyond full scale deflection.

5—20. REMOVAL OF THE ANTENNA ASSEMBLY. To remove antenna assembly E30, proceed as follows:

a. Remove the signal generator from the case (par. 5—7) and separate the panel from the chassis (par. 5—8).

b. Pull antenna cable W3 through to the underside of the chassis; remove the rubber grommet H32 from the chassis along with the cable.

c. Remove the antenna assembly by unscrewing the holding screws from the top of the chassis.

5—21. REPLACEMENT OF THE ANTENNA ASSEMBLY. To replace the antenna assembly, proceed as follows:

a. With the chassis separated from the panel set the antenna assembly E30 into its rectangular hole in the chassis so that the antenna cable is on the side away from the blower.

b. Screw the four 8-32 binding head screws which hold the antenna to the two angle irons on the chassis so that the antenna is loosely held in position. Loosen the four screws holding the two angle irons to the chassis.

c. Set the chassis into the case at the same time manipulate the antenna from the top of the chassis and align the ten camloc screws. Insert and tighten two shaft and stud assemblies which hold the chassis assembly to the case. Tighten the four binding head screws holding the angle irons to the chassis.

d. Remove chassis from case and tighten the four binding head screws holding the antenna to the angle irons. Insert antenna cable W3 through the hole in the chassis and set grommet H32 in the hole.

5—22. ADJUSTMENTS. The adjustments discussed in this section, table XI, cover the setting of the output voltages of the power supplies, the klystron, the beam current, and the meter COARSE control. See figures 6—8 and 6—9 for location of these controls.

Note

All adjustment control shafts are provided with shaft locks. Use a hexagon spin-tite wrench to loosen the lock before attempting to rotate the shaft. After satisfactory adjustment has been completed, be sure to lock the shaft. Then recheck to see that tightening of the shaft has not affected the control setting.

5—23. LUBRICATION.

5—24. GENERAL. Gear teeth and moving shafts are factory lubricated with a combination of molycote powder and Esso Univis P38 oil mixed together to a light paste. No further lubrication is required during the life of the equipment.

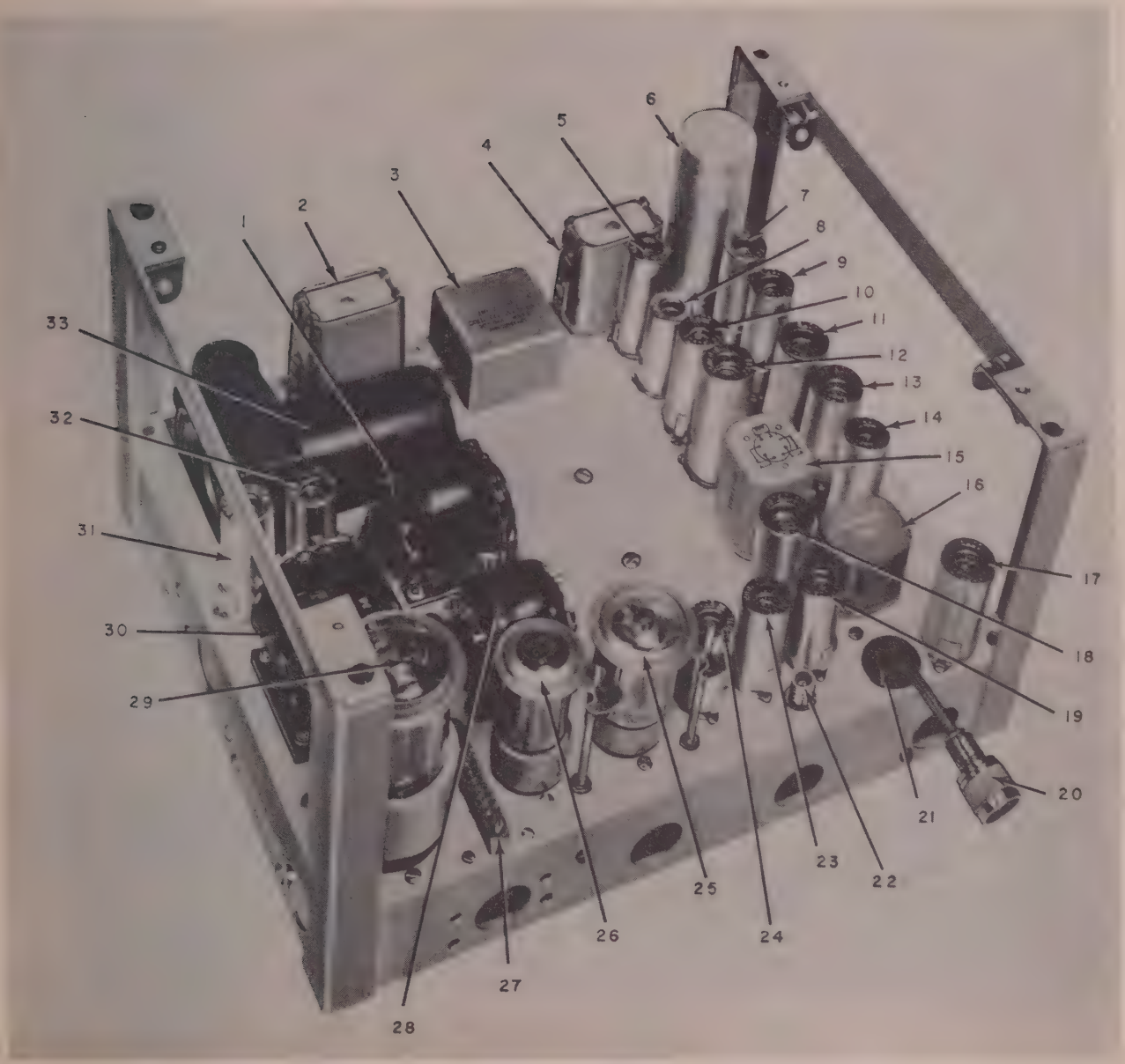
5—25. Should lubrication become necessary apply the recommended lubricant sparingly with a small brush.

5—26. INSPECTION SCHEDULE. The signal generator is a precision instrument with carefully calibrated frequency, power output and pulse rate. It is essential that the signal generator be maintained in proper operating condition so that it may perform its functions with the required accuracy. Periodic checks will serve to insure reliable performance of the equipment. Table XII lists the parts requiring regular inspection, the times at which inspection is required, and the specific conditions or operations to be performed.

TABLE XII. INSPECTION SCHEDULE

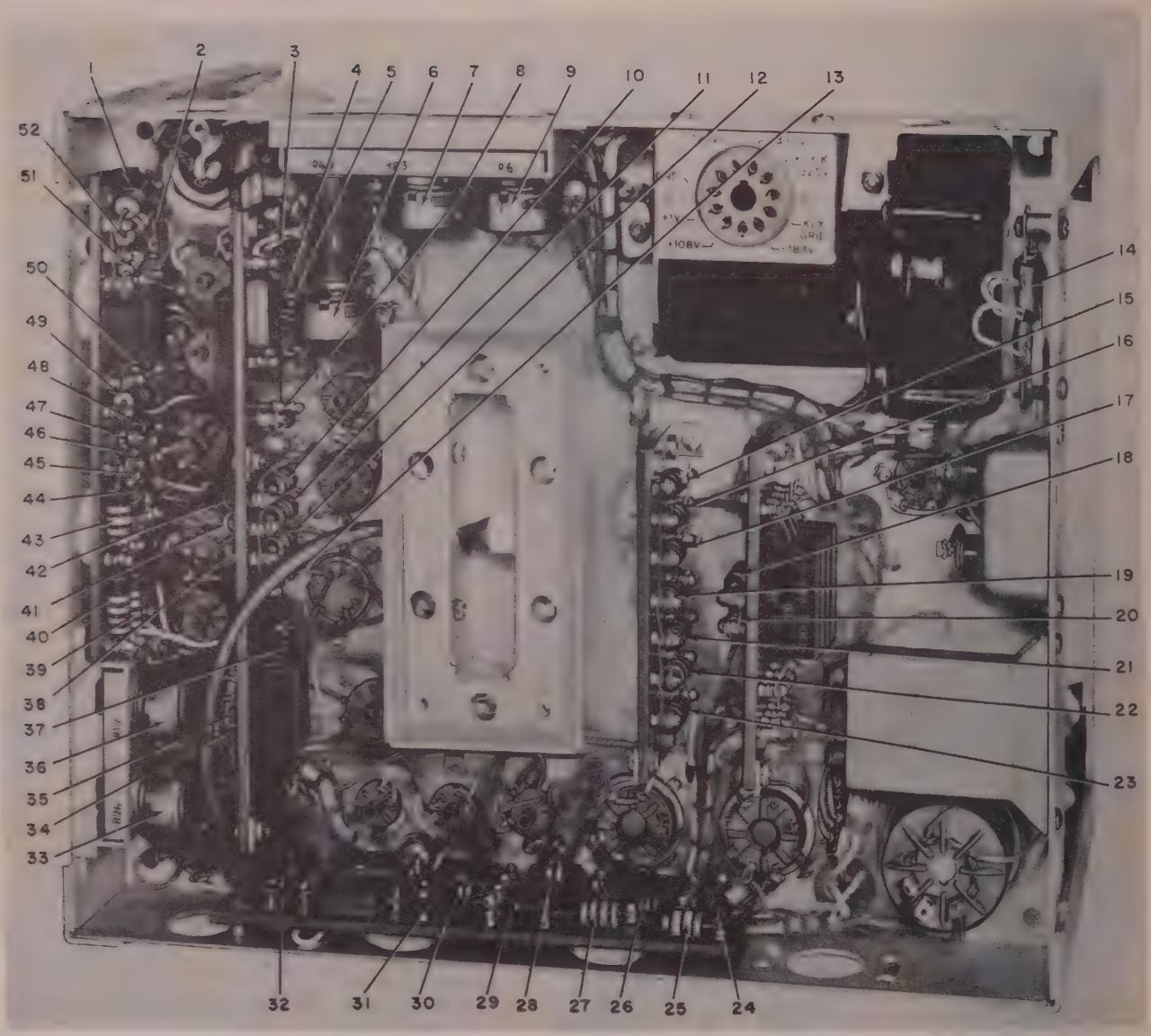
W = Weekly M = Monthly Q = Quarterly

Component	*Inspection*	Time
Ventilating screens inside the case and on panel.	Screens free of dirt and corrosion.	M
Power cord, video and rf cables.	Refer to table VIII.	W
Case, front panel and front panel controls, fuses.	Refer to table VIII.	M
Rear of panel, top and bottom of chassis.	Connections mechanically secure and not corroded. Oscillator, thermistor and attenuator drives clean and moving freely.	M
Resistors and capacitors.	Refer to table VIII.	M
Tubes, except klystron.	Refer to table VIII.	M
Delay relay K1, and hold relay K2.	Check 75-second delay cycle. Power should be applied to the beam supply after 75 seconds.	M
Wiring.	Wires properly insulated and cabled, and securely clamped.	Q
Blower motor.	Check for air exhaust at vent in panel.	100 hours



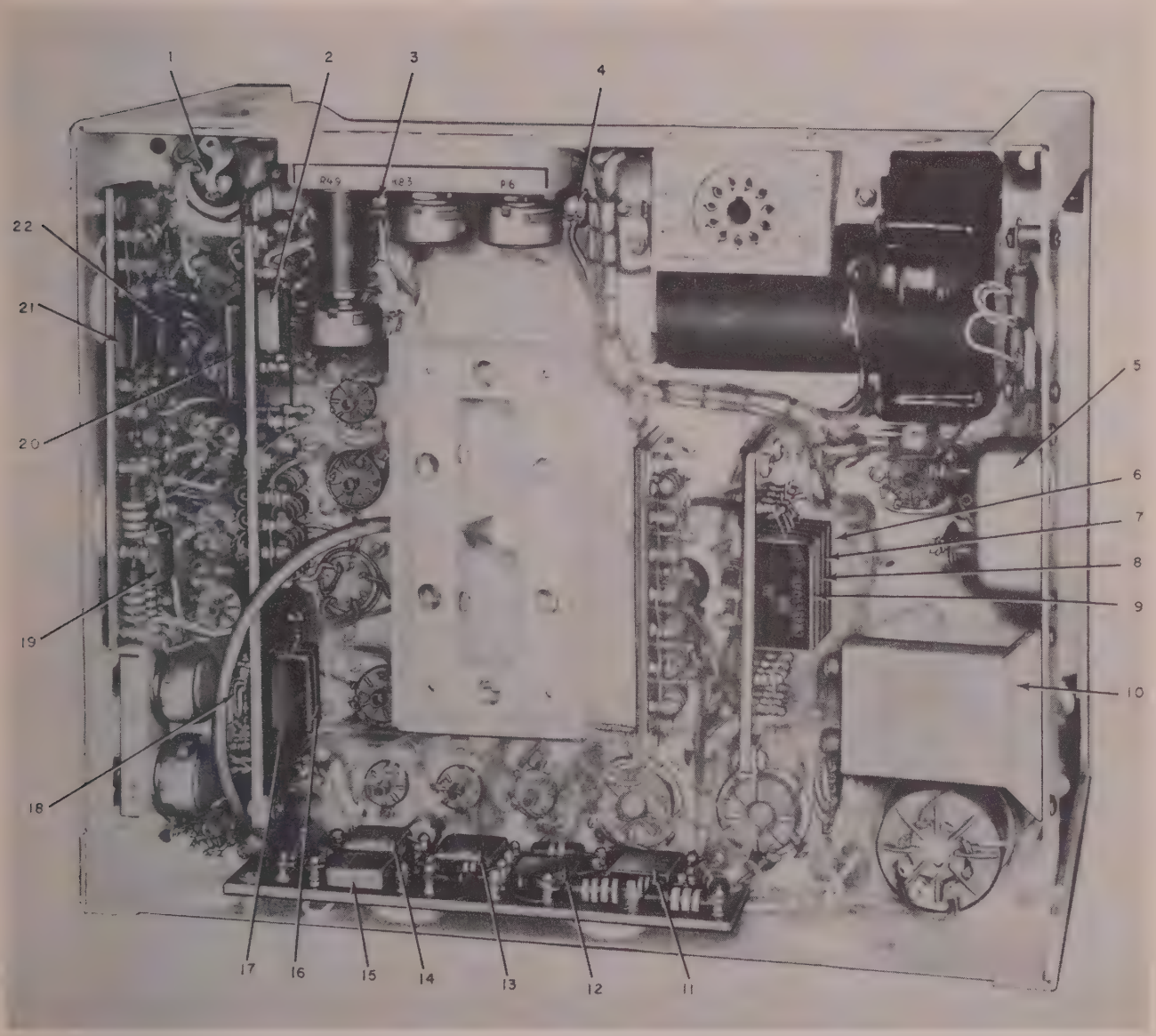
1. Transformer T4
2. Capacitor C30
3. Capacitor C4
4. Capacitor C25
5. Electron tube V2
6. Capacitor C21
7. Electron tube V1
8. Electron tube V3
9. Electron tube V8
10. Electron tube V4
11. Electron tube V11
12. Relay K1
13. Electron tube V10
14. Electron tube V12
15. Relay K2
16. Transformer T2
17. Electron tube V6
18. Electron tube V5
19. Electron tube V19
20. Connector, plug P3
21. Grommet H32
22. Connector, receptacle J10
23. Electron tube V18
24. Electron tube V17
25. Electron tube V16
26. Electron tube V15
27. Connector, receptacle J8
28. Transformer T3
29. Electron tube V9
30. Transformer T1
31. Electron tube V14
32. Electron tube V13
33. Blower Motor B1

Figure 5–4. Chassis, Top View



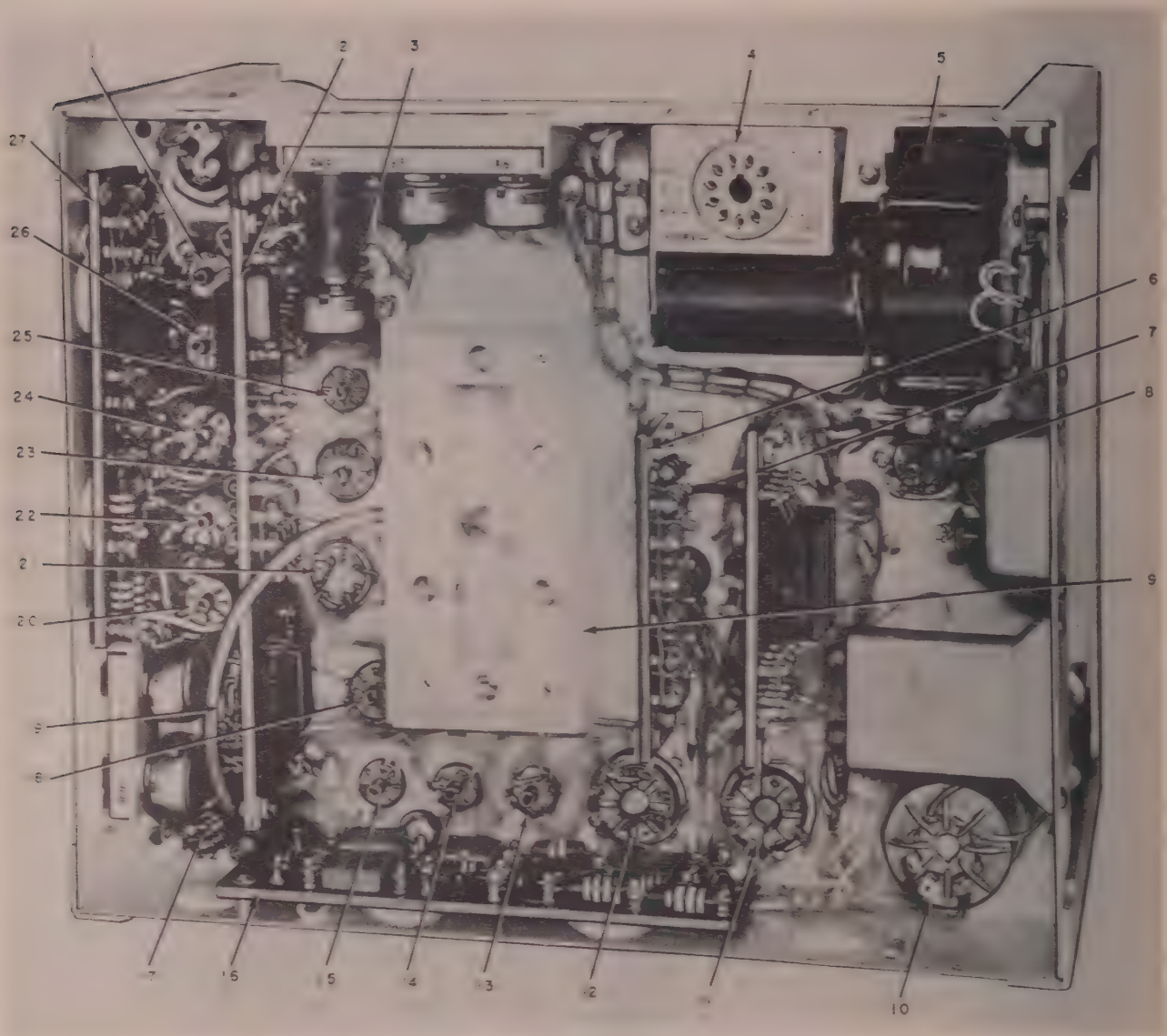
1. R46	14. R60	27. R75	40. R8
2. R47	15. R18	28. R80	41. R30
3. R2	16. R19	29. R76	42. R34
4. R5	17. R20	30. R85	43. R9
5. R1	18. R61	31. R82	44. R43
6. R49	19. R21	32. R13	45. R42
7. R83	20. R62	33. R26	46. R40
8. R7	21. R22	34. R15	47. R41
9. R6	22. R23	35. CR1	48. R39
10. R33	23. R24	36. R12	49. R38
11. R31	24. R73	37. R17	50. R34
12. R29	25. R77	38. R27	51. R50
13. R28	26. R84	39. R10	52. R45

Figure 5–5. Chassis, Bottom View No. 1 (Resistors)



1. C21	7. C3	13. C11	19. C8
2. C7	8. C2	14. C12	20. C5
3. C25	9. C1	15. C13	21. C24
4. C4	10. C34	16. C18	22. C22
5. C27	11. C31	17. C17	
6. C28	12. C33	18. C16	

Figure 5—6. Chassis, Bottom View No. 2 (Capacitors)



1. Socket XV1
2. Terminal board TB5
3. Socket XV2
4. Test point socket J5
5. Blower Motor B1
6. Terminal board TB1
7. Terminal board TB2
8. Socket XV13
9. Antenna assembly E30
10. Socket XV9
11. Socket XV15
12. Socket XV16
13. Socket XV17
14. Socket XV18
15. Socket XV19
16. Terminal board TB4
17. Socket XV6
18. Socket XV5
19. Transformer T2
20. Socket XV12
21. Relay K2
22. Socket XV10
23. Socket XK1
24. Socket XV11
25. Socket XV4
26. Socket XV8
27. Terminal borad TB3

Figure 5–7. Chassis, Bottom View No. 3 (Miscellaneous)

SECTION VI

FIELD MAINTENANCE

6—1. SCOPE.

6—2. This section discusses maintenance which may be performed on the signal generator at the field level. Performance standards, trouble analysis charts, and repair and adjustment procedures are described.

6—3. MINIMUM PERFORMANCE STANDARDS FOR FIELD MAINTENANCE.

6—4. Minimum performance standards for field maintenance and methods of checking them are given in table XIII.

6—5. CHECKING ATTENUATOR DIAL POWER OUTPUT CALIBRATION.

6—6. The power output of the signal generator is standardized at the factory to one milliwatt ± 3 db. Its accuracy over the entire band is checked in the following manner:

a. Set up the signal generator and test equipment as shown in figure 6—1. Mount the bolometer on DIRECT RF OUTPUT receptacle J2.

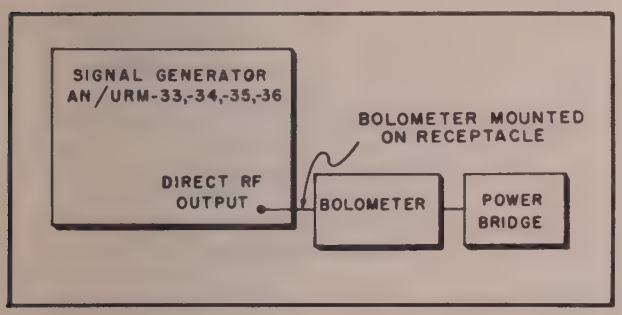


Figure 6—1. Test Set-up for Checking Power Output

CAUTION

To prevent high power output from causing excessive needle deflection which may damage the meter, turn POWER SET control to its maximum clockwise position.

b. Turn the power bridge and signal generator power ON. Allow fifteen minutes for warm-up.

c. Zero set meter M1 on the signal generator.

d. Set Output Switch S3 to DIRECT RF OUTPUT.

e. Set FREQUENCY IN KILOMEGACYCLES dial to the low end and adjust the output reference level (1 mw).

f. Turn the ATTENUATOR knob until the —DBM dial reads "0".

g. Record the reading of the test equipment power bridge meter and the frequency of the signal generator.

h. Slowly turn the frequency dial toward the high end until a dip or a rise in the power output is indicated on meter M1.

i. Reset the output reference level and repeat step f.

j. Record the reading of the test equipment power bridge meter and the frequency of the signal generator.

k. Continue turning the frequency dial to the high end, resetting the output reference level and zeroing the —DBM dial at each dip or rise of meter M1. Record the readings for each dip or rise.

l. Use table XIV and convert the highest and the lowest recorded power bridge readings to decibels.

Note

If the difference between the upper and lower limits is greater than 6 db, the thermistor probe may be defective.

m. The minimum standard is ± 3 db. If the minimum standard cannot be met, and there is not more than 6 db over-all error, the —DBM ATTENUATOR dial is not properly set. Refer to paragraph 6—57 for resetting the ATTENUATOR dial.

TABLE XIII. MINIMUM PERFORMANCE STANDARDS FOR FIELD MAINTENANCE

Operational Characteristics	*Minimum Standard*	*Remarks*
Power output	1 mw at zero dbm. Calibration to be accurate to ± 3 db from 1,000 mc to 2,300 mc.	Refer to paragraph 6—5.
Frequency range	1,000 mc to 2,300 mc without hiatus.	Refer to paragraph 6—7.
Frequency calibration	± 1% at normal room ambient. ± 1½% under any service conditions.	Refer to paragraph 6—7.
Pulse top	Flat to ± 10% of the peak pulse amplitude points.	Refer to paragraph 6—9.
Pulse width	3 ± 0.5 μs measured at the 50% peak amplitude points.	Refer to paragraph 6—9.
Pulse rise and decay time	0.35 μs measured between 10 and 90% amplitude points.	Refer to paragraph 6—9.
Video pulse amplitude	1.25 ± 0.5 volts terminated into a 50 ohm load.	Refer to paragraph 6—9.

TABLE XIV. MILLIWATTS VS. DECIBELS

Milliwatts		Decibels	Milliwatts		Decibels	Milliwatts		Decibels	Milliwatts		Decibels
Loss (—)	Gain (+)		Loss (—)	Gain (+)		Loss (—)	Gain (+)		Loss (—)	Gain (+)	
1.0000	1.000	0	.7499	1.334	1.25	.5623	1.778	2.50	.4217	2.371	3.75
.9886	1.012	.05	.7413	1.349	1.30	.5559	1.799	2.55	.4169	2.399	3.80
.9772	1.023	.10	.7328	1.365	1.35	.5495	1.820	2.60	.4121	2.427	3.85
.9661	1.035	.15	.7244	1.380	1.40	.5433	1.841	2.65	.4074	2.455	3.90
.9550	1.047	.20	.7161	1.396	1.45	.5370	1.862	2.70	.4027	2.483	3.95
.9441	1.059	.25	.7079	1.413	1.50	.5309	1.884	2.75	.3981	2.512	4.00
.9333	1.072	.30	.6998	1.429	1.55	.5248	1.905	2.80	.3936	2.541	4.05
.9226	1.084	.35	.6918	1.445	1.60	.5188	1.928	2.85	.3890	2.570	4.10
.9120	1.096	.40	.6839	1.462	1.65	.5129	1.950	2.90	.3846	2.600	4.15
.9061	1.109	.45	.6761	1.479	1.70	.5070	1.972	2.95	.3802	2.630	4.20
.8913	1.122	.50	.6683	1.496	1.75	.5012	1.995	3.00	.3758	2.661	4.25
.8810	1.135	.55	.6607	1.514	1.80	.4955	2.018	3.05	.3715	2.692	4.30
.8710	1.148	.60	.6531	1.531	1.85	.4898	2.042	3.10	.3673	2.723	4.35
.8610	1.161	.65	.6457	1.549	1.90	.4842	2.065	3.15	.3631	2.754	4.40
.8511	1.175	.70	.6383	1.567	1.95	.4786	2.089	3.20	.3589	2.786	4.45
.8414	1.189	.75	.6310	1.585	2.00	.4732	2.113	3.25	.3548	2.818	4.50
.8318	1.202	.80	.6237	1.603	2.05	.4677	2.138	3.30	.3508	2.851	4.55
.8222	1.216	.85	.6166	1.622	2.10	.4624	2.163	3.35	.3467	2.884	4.60
.8128	1.230	.90	.6095	1.641	2.15	.4571	2.188	3.40	.3428	2.917	4.65
.8035	1.245	.95	.6026	1.660	2.20	.4519	2.213	3.45	.3388	2.951	4.70
.7943	1.259	1.00	.5957	1.679	2.25	.4467	2.239	3.50	.3350	2.985	4.75
.7852	1.274	1.05	.5888	1.698	2.30	.4416	2.265	3.55	.3311	3.020	4.80
.7762	1.288	1.10	.5821	1.718	2.35	.4365	2.291	3.60	.3273	3.055	4.85
.7674	1.303	1.15	.5754	1.738	2.40	.4315	2.317	3.65	.3236	3.090	4.90
.7586	1.318	1.20	.5689	1.758	2.45	.4266	2.344	3.70	.3199	3.126	4.95

6—7. CHECKING FREQUENCY IN KILOMEGACYCLES DIAL FOR RANGE AND CALIBRATION.

6—8. To check the signal generator to determine whether it meets minimum standards of frequency range and calibration, set up the signal generator as shown in figure 6—2, and check its output at both ends of the dial and also at three intermediate points. If the dial is off calibration, refer to paragraph 6—55 for adjustment. If the frequency limits cannot be reached, the choke is probably improperly set. Refer to paragraph 6—63. Refer to Table XIII for the minimum standards.

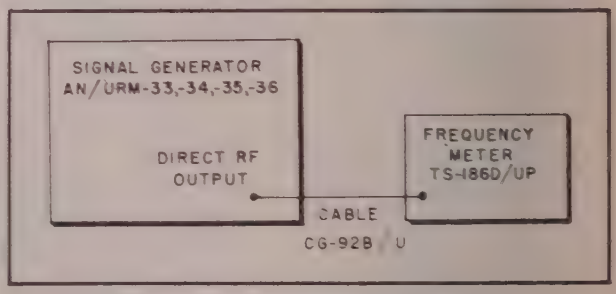


Figure 6—2. Test Set-up for Checking Frequency Range

6—9. CHECKING PULSE SHAPE.

6—10. To check the video pulse shape, proceed as follows:

a. Connect the signal generator as shown in figure 6—3. Set Function Switch S2 in PULSE position.

b. Turn power on and allow fifteen minutes for warm-up.

c. Check shape for minimum standard. Refer to table XIII.

6—11. CHECKING PULSE REPETITION RATE.

6—12. To check the pulse repetition rate, proceed as follows:

a. Connect the signal generator as shown in figure 6—4. Set Function Switch S2 to PULSE position. Turn power on and allow fifteen minutes for warm-up.

b. Adjust the audio oscillator frequency to approximately 1,000 cps until the Lissajous figure stands still and one

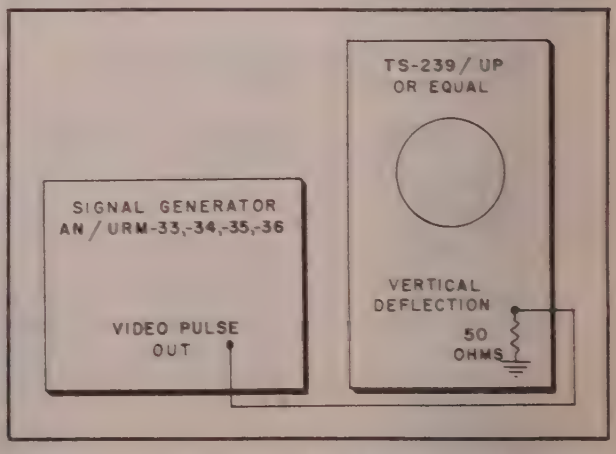


Figure 6—3. Test Set-up for Checking Pulse Shape

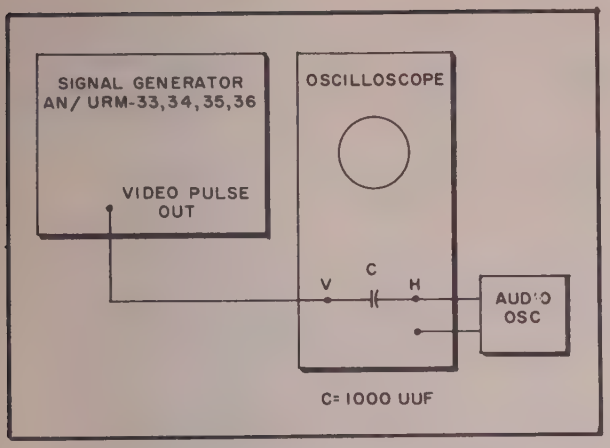


Figure 6—4. Test Set-up for Checking Pulse Repetition Rate

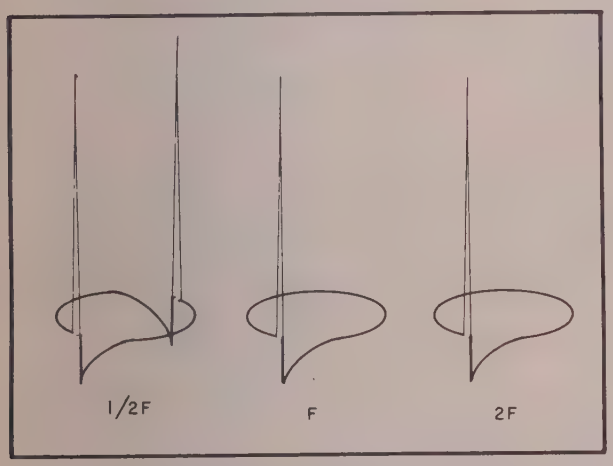


Figure 6—5. Lissajous Figures for Checking Pulse Repetition Rate

pulse is observed. (See figure 6—5.) Note the audio oscillator frequency.

c. Set the audio oscillator at half the frequency noted in step b. above. Two pulses indicate that the audio oscillator is set at half the signal generator prf. If one pulse is observed, it indicates that the audio oscillator frequency is set at the pulse repetition rate and the original setting that produced the previous single pulse is twice the generator frequency. Check by turning the audio oscillator to half the last setting. Two pulses should be observed. In other words, two pulses indicate that the audio oscillator is set at one-half the repetition rate.

d. If the pulse repetition rate does not fall within the range of 900 to 1,100 pps, it may be adjusted by resetting the REP RATE ADJ. R12.

e. An alternate method of checking the repetition rate is by means of a calibrated video scope. Refer to figure 6—3 for setup.

WARNING

THE OPERATION OF THIS EQUIPMENT INVOLVES THE USE OF HIGH VOLTAGES DANGEROUS TO LIFE. ALWAYS REMOVE THE POWER CABLE FROM ITS RECEPTACLE, J1, BEFORE ATTEMPTING TO MAKE REPAIRS OR TO REPLACE A TUBE.

6—13. ELECTRONIC AND MECHANICAL TROUBLE ANALYSIS.

6—14. GENERAL. Failure to meet a minimum performance standard as given in table XIII will require an analysis of the possible causes of such failure. The theory of operation of this equipment as given in section IV of this handbook should be thoroughly understood before making an attempt to analyze trouble in the signal generator. Table XV, Electronic and Mechanical Trouble Analysis, lists troubles, probable causes and remedies. The references given in the table will aid in tracing the cause of failure to the defective stage and part. Refer also to Table VIII, Trouble Analysis Procedure For Organizational Maintenance.

6—15. FIELD CHECKING THE MODULATOR SECTION.

6—16. The modulator section comprises the pulse generator, pulse shaper and keyer circuits. Refer to figure 7—3 for waveforms of each stage. In general, if the correct waveform is seen at the input of any stage, but an improper one at the output of the same stage, a replacement tube should be tried before attempting further tests of the circuit. Refer to paragraph 5—13 for detailed trouble analysis of this section. To make waveform checks of the modulator section, proceed as follows:

a. With the power off, remove delay relay K1.

b. Connect the signal generator to a TS-239/UP oscilloscope as shown in figure 6—3, using the fabricated cable described in paragraph 2—10.

c. Turn the signal generator and oscilloscope power on. Allow fifteen minutes for warm-up.

d. Set Function Switch S2 to PULSE position and adjust the oscilloscope to give a single pulse.

e. Compare the pulse on the oscilloscope with the pulse form shown for VIDEO PULSE OUT in table VI or figure 7—3.

f. Remove the fabricated cable connecting the generator and the oscilloscope.

g. Replace the cable with a probe and check the waveforms across the test points shown in figure 7—3.

h. After completion of the above steps, turn OFF the power and replace delay relay K1.

TABLE XV. ELECTRONIC AND MECHANICAL TROUBLE ANALYSIS

Trouble	*Probable Cause*	*Remedy*
No output from VIDEO PULSE OUT receptacle J4.	Pulse generator V5A.	Change tube V5. Refer to paragraph 6—15.
Improper pulse repetition rate.	Misadjustment of REP RATE ADJ. R12.	Adjust. Refer to paragraph 6—11.
	Defective control R12.	Replace.
	Defective capacitors C11, C12, or C13.	Replace.
Overshoot of video pulse or multiple pulses.	Defective crystal diode CR1.	Replace CR1, type 1N69.
Meter M1 cannot be zero set.	Bridge circuit or bridge circuit supply.	Refer to paragraphs 5—11 and 5—15.
	Thermistor probe defective.	Refer to paragraph 6—34.
No indication of power output on meter M1.	Power supply voltages not present at klystron socket pins.	Check supply voltages.
	Poor tracking of repeller voltage.	Check the repeller voltages. Refer to paragraph 6—17.
	No voltage at the socket (P1) inside the oscillator barrel.	If proper voltage exists at pin jack J7, replace the inner conductor assembly. See paragraphs 6—42 and 6—44.
	Defective klystron tube.	Replace klystron tube. Refer to paragraph 6—25.
Insufficient power output.	Beam supply, reflector supply, or bias and modulator supply.	Refer to paragraph 5—11.
	Incorrect setting of beam current.	Reset the BEAM CURRENT ADJ. R26. Refer to table XI.
	Defective reflex klystron.	Replace klystron tube. Refer to paragraphs 6—25 through 6—28.
	Poor tracking.	Refer to paragraph 6—19, and check the setting of the track potentiometers.
	Thermistor probe defective.	Replace the thermistor probe assembly. Refer to paragraph 6—34.
Meter pointer fluctuates.	Improper voltage or defective tubes in bridge supply.	Refer to paragraph 5—11 and check the power supplies.
	Defect in a-c source.	Check power input source.
No rf from DIRECT RF OUTPUT receptacle J2.	Function Switch S3 defective in DIRECT RF OUTPUT position.	Refer to paragraph 6—21.
	Attenuator defective.	Refer to paragraph 6—31. Recalibrate the power output. Refer to paragraph 6—57.
No rf from ANTENNA OUTPUT.	Function Switch S3 defective in ANTENNA OUTPUT position.	Refer to paragraph 6—21.
	Antenna assembly.	Refer to step 6, part II of table VIII.
No rf pulse.	Pulse shaper or keyer circuits.	Refer to paragraph 6—15.
Irregular or erratic rf pulse, or no pulse visible over part of the tuning range.	Incorrect voltage applied to repeller of reflex klystron tube due to poor tracking.	Check settings of track potentiometers. Refer to paragraph 6—19.
	Power source not within rated voltage or frequency.	Power source should be 115 volts, ± 10%, 380 to 1,000 cps.
	Defective reflex klystron tube.	Replace klystron tube.
Rf pulse not flat within ± 10% or overshoot is seen on trailing edge of pulse.	Improper tracking.	Refer to paragraph 6—19.
	Improper setting of POWER SET or ATTENUATOR controls.	Reset POWER SET and ATTENUATOR controls. Check calibration of power output. Refer to paragraph 6—5.
Frequency range does not reach upper limit.	Choke assembly not properly set or setscrews holding the choke pushrods O 11 are loose.	Reset the choke assembly. Refer to paragraph 6—63.
	Klystron tube not oscillating.	Replace reflex klystron tube V7.
Frequency range does not reach lower limit.	Choke assembly not properly set or setscrews holding the choke pushrods O 11 are loose.	Refer to paragraph 6—63. Reset the choke assembly.
Improper frequency calibration.	Slipping of the FREQUENCY IN KILOMEGACYCLES dial due to loosening of screws holding it.	Recalibrate the frequency dial. Refer to paragraph 6—55.
	Loose setscrews holding the choke pushrods O 11.	Reset the choke assembly. Refer to paragraph 6—63.

6—17. CHECKING REPELLER VOLTAGES.

6—18. The nominal repeller voltages given in table XVI may be used for tracing the cause of defective operation of the tracking circuit. Actual voltages may differ from the nominal voltages, but a defect within the tracking circuit will usually alter the repeller voltages substantially from the nominal voltages given in the table. Refer to paragraph 6—66 for the procedure to be used in setting the potentiometers.

TABLE XVI. FREQUENCY VS REPELLER VOLTAGE

(Test points J7 to (10))

FREQUENCY IN KILOMEGACYCLES dial at	*Nominal Voltage*
1.00	90
1.08	115
1.21	135
Rotate the frequency dial from the low to the high frequency until a click is heard at about 1.25. Rotate the dial back and set it on the low side just before the frequency at which the click is heard.	155
Rotate the frequency dial (slowly) toward the high side until the click is noted again.	40
1.50	80
1.87	145
2.30	220

6—19. CHECKING THE SETTING OF THE TRACKING POTENTIOMETER WIPER.

6—20. To check the tracking potentiometer wiper setting, proceed as follows:

a. Turn the power off.

b. Set the RF OSC knob completely *clockwise*.

c. Connect an ohmmeter from the wiper marked "2" to the high point marked "3" on the potentiometer.

d. The resistance reading should be 4,000 ohms. In the event the resistance is incorrect, refer to paragraph 6—70, and reset the tracking potentiometer wiper.

e. Move the ohmmeter probe from the high point to the low point marked "1" on the potentiometer.

f. Turn the RF OSC knob completely *counterclockwise* watching the meter. Set meter on highest range. The resistance should never reach infinity. In the event that the resistance does, it signifies that the wiper is incorrectly set. Refer to paragraph 6—70 for resetting the tracking potentiometer wiper.

6—21. CHECKING OUTPUT SWITCH S3.

6—22. Check the output switch, S3, in its two positions, DIRECT RF OUTPUT and ANTENNA OUTPUT. To check the switch, proceed as follows:

a. Set the output switch in DIRECT RF OUTPUT position. With power OFF, measure the resistance with an ohmmeter from the center of DIRECT RF OUTPUT connector J2 to ground. The normal reading is 50 ohms. This includes resistor R36. If the reading is normal, refer to step d. below, and check the switch in ANTENNA OUTPUT position. If the reading is abnormal, proceed with step b.

b. Unscrew hex nut H12 at the coax switch termination of the attenuator cable and withdraw the cable from the switch. Be careful not to lose the contact spring and cup as the cable is pulled out.

c. Measure the resistance with an ohmmeter from DIRECT RF OUTPUT, connector J2, to test point (C) inside the coax switch at the opening from which the attenuator cable has been removed. Normal resistance is zero ohms.

d. Set the switch to ANTENNA OUTPUT position.

e. Unscrew connector P3 from connector J3.

f. Use an ohmmeter and measure the resistance from the center of connector J3 to test point (C) . Normal resistance is zero ohms.

6—23. REMOVAL.

6—24. GENERAL. The mechanical drive systems are designed to last far beyond the life of the electrical parts of the instrument and should not be tampered with unless a mechanical breakdown occurs. This will normally be required only if the signal generator is dropped or receives a sharp blow which results in misalignment of gears and shafts. A disassembly and reassmbly procedure is given in the event that a mechanical failure does occur. Mechanical readjustments should be made only as a last resort when necessary to correct malfunctions which cannot be remedied by the electrical adjustments described in this section, and in section V of this handbook. Certain mechanical adjustments or removal and replacement of the mechanical drives necessitate recalibration of the signal generator. Replacement of the reflex klystron oscillator tube necessitates a similar recalibration.

WARNING

OPERATION OF THIS EQUIPMENT INVOLVES THE USE OF HIGH VOLTAGES. ALWAYS REMOVE THE POWER CABLE FROM ITS RECEPTACLE, J1, BEFORE ATTEMPTING TO MAKE REPAIRS OR TO REPLACE A TUBE.

6—25. REMOVAL OF THE KLYSTRON TUBE.

6—26. PRELIMINARY. In order to remove the klystron tube, the panel and chassis assembly must be removed from the case and the panel separated from the chassis. Refer to paragraphs 5—7 and 5—8.

6—27. REMOVAL PROCEDURE. To remove the klystron tube, proceed as follows:

a. Loosen clamp H13 on tube cover E7 by unscrewing the clamp screw. (See figure 5—3.)

b. *Gently* slide back the tube cover until the tube socket is exposed.

c. Remove the socket from the tube.

d. Use a spanner wrench and *loosen* klystron retainer nut H14.

Note

Do NOT remove the retainer nut completely. A half counterclockwise turn is sufficient to release the locking action.

e. Use one hand to protect and guide the klystron tube. With the other hand grasp the base of the klystron tube

and gently rotate in a clockwise direction, at the same time pull the tube from its spring fingers within the cavity.

6—28. REPLACEMENT PROCEDURE. If in removing the klystron tube the knurled retaining nut is accidentally removed, the washer and retainer spring will come out of the barrel. It is necessary to replace these parts in proper order before replacing the klystron. The retainer spring must be inserted first. After replacing the retainer parts, proceed as follows:

a. Carefully insert a replacement klystron tube into the oscillator barrel and gently push the tube toward the center of the cavity.

b. Press the tube (using a slow clockwise rotation) in against a noticeable resistance. This resistance is an indication that the inner conductor fingers are sliding over the collar at the end of the tube.

c. Continue the slow clockwise rotation and pressure on the tube until it meets a positive stop. This signifies that the klystron is seated at the shoulder of the fingers and the springs are properly engaged.

d. Use a spanner wrench and tighten the knurled retainer nut a quarter to a half-turn clockwise.

e. Attach the socket to the base of the klystron tube.

f. Replace the tube cover and tighten the screw on the clamp holding the cover in position.

g. Turn BEAM CURRENT ADJ. R26 completely counterclockwise.

h. Connect a voltmeter to test point 10 and 8 Set Function Switch S2 in CW position.

i. Turn set on. After the delay relay clicks in, adjust R26 to give 10 volts on meter.

j. Refer to paragraph 6—66 and check the repeller tracking voltages.

k. Recheck the 10 volts adjustment. (See step i above.) Lock R26 in position.

l. Recalibration of frequency and power output may be necessary. Refer to paragraphs 6—55 and 6—57.

6—29. REMOVAL OF ATTENUATOR AND POWER SET DIAL ASSEMBLIES.

Note

Removal of either the attenuator dial or the POWER SET fluted knob will necessitate recalibration of the power output. Refer to paragraph 6—57 for recalibration procedure.

6—30. To remove the ATTENUATOR and POWER SET dial assemblies, proceed as follows:

a. Unscrew the two setscrews holding the ATTENUATOR knob and remove the knob.

b. Lift the window retainer spring by inserting a scribe or other sharp point under the inside edge of the fluted POWER SET knob. Set the scribe at the point where the spring is split and pull the spring out.

c. Lift out the POWER SET window indicator.

d. Unscrew the two setscrews holding the attenuator dial to the shaft and pull off the dial assembly.

e. Note the position of the pin on the inside of the metal dial when the fluted knob is completely counterclockwise. Unscrew the three binding head screws which can be seen when the attenuator dial assembly is removed. Lift the thermistor dial out of the fluted knob.

f. Two flat head screws can be seen. Remove screws and fluted knob.

6—31. REMOVAL OF ATTENUATOR PROBE ASSEMBLY.

(*See figures* 5—2 *and* 5—3.)

6—32. To remove attenuator probe assembly AT1, proceed as follows:

a. Unscrew the binding head screw attaching the cable clamp, H15, to the top of thermistor and attenuator drive support O 8.

b. Unscrew hex nut H12 at the output switch termination of the attenuator cable, W2, and withdraw the cable from the switch. Be careful not to lose the cup contact or the contact spring as the cable is pulled out.

c. Loosen the two spline head setscrews on attenuator coupling O 12 and withdraw the attenuator probe assembly from the attenuator barrel W5 and the attenuator coupling.

d. To replace the attenuator probe assembly, proceed as follows: Loosen the stopscrew nut H10 and turn screw in a clockwise direction 3 complete turns to permit a safety factor when replacing probe assembly.

e. Turn ATTENUATOR knob completely clockwise.

f. To replace the attenuator probe assembly it is necessary that the grounded edge on the probe tip be oriented. Proper orientation is established by setting the grounded edge toward the drive shaft, O 2. Then follow the above steps in reverse order.

g. Reset stopscrew H10 to the position which will protect the cavity from too great a probe insertion.

CAUTION

Damage to the cavity will result if care is not exercised when installing probe assembly.

h. Refer to paragraph 6—62 and check the drive stops.

6—33. REMOVAL OF THERMISTOR PROBE ASSEMBLY.

6—34. To remove thermistor probe assembly CP1, proceed as follows:

a. Unsolder the thermistor cable inner conductor from its connection on terminal board TB6.

b. Remove the clamps and ties which interfere with the removal of the thermistor probe.

c. Turn POWER SET knob fully clockwise. Loosen the two setscrews holding the thermistor yoke assembly, O 7, to the thermistor drive shaft.

d. Carefully slide out the thermistor probe from the thermistor barrel.

e. Separate the thermistor probe assembly from the yoke by gently pulling them apart.

6—35. REPLACEMENT. Set the proper thermistor probe insertion by rotating POWER SET knob fully counterclockwise.

a. Carefully advance thermistor probe assembly until probe tip just hits the hat in the cavity.

6—36. REMOVAL OF THE THERMISTOR DISC MOUNT ASSEMBLY.

6—37. To remove thermistor disc mount assembly CP2, proceed as follows:

a. Perform steps b. through d. as outlined in paragraph 6—34.

b. Remove Output Switch S3 by first removing the knob and the three 6-32 screws, nuts and lockwashers.

c. Unscrew the 4-40 round head screw holding the end plate of the thermistor disc mount assembly. Remove the screw and lockwasher and slide the end plate off the barrel.

d. Pull off the disc thermistor shield.

e. Loosen the two 4-40 flat head screws which clamp the thermistor disc mount to the barrel and slide off the disc mount assembly. These screws are the lower two of the four which attach the thermistor disc to its mount.

6—38. REPLACEMENT. To replace the thermistor disc mount assembly, follow the above procedure in reverse order.

6—39. REMOVAL OF OSCILLATOR BARREL ASSEMBLY.

6—40. To remove the oscillator barrel assembly, proceed as follows:

a. Refer to paragraph 6—25 and remove the klystron tube.

b. Refer to paragraph 6—32 step c. and remove the attenuator probe assembly from the oscillator assembly. Scribe a line on the attenuator drive yoke to represent the center line of the attenuator barrel.

c. Refer to paragraph 6—34 steps b., c. and d. and remove thermistor probe assembly W4 from the oscillator assembly.

d. Refer to paragraph 6—37 steps b. through e. and remove the thermistor disc mount assembly.

e. Unsolder the repeller lead at the potentiometer mounting board TB7, and remove lead from harness.

f. Loosen the two spline head set screws H41 in the yoke of the oscillator drive, O 52. Free the two choke pushrods O 11 from the yoke.

g. Loosen the two binding head screws H43 which clamp the barrel support, A6, over the barrel, Z1.

h. Unscrew the barrel lock nut, H45.

i. Remove Output Switch S3 by first removing the knob and the three 6-32 screws, nuts, and lockwashers.

j. Withdraw the barrel from the oscillator support. (It may be necessary to pry the jaws of the barrel support, A6, open.) Remove the inner conductor and choke from the barrel.

6—41. REPLACEMENT OF OSCILLATOR BARREL ASSEMBLY. To replace the oscillator barrel assembly, proceed as follows:

a. Follow steps i. and j. of paragraph 6—40 in reverse order.

b. Replace barrel locknut, H45. Do not tighten.

c. Align oscillator barrel so that the attenuator and thermistor barrels are parallel to the panel and line up with the scribed line on the attenuator drive yoke. Refer to paragraph 6—40, step b.

d. Tighten screws H43.

e. Adjust choke assembly (steps c. through h. par. 6—65).

f. Tighten barrel locknut H45.

g. Replace klystron tube (par. 6—28).

6—42. REMOVAL OF INNER CONDUCTOR AND CHOKE ASSEMBLY.

6—43. To remove the inner conductor and choke assemblies, proceed as follows:

a. Refer to paragraph 6—25 and remove the klystron tube.

b. Remove the oscillator yoke guide rod O 2 by loosening the two setscrews H82.

c. Loosen the setscrews H41 and push the pushrods O 11 into the cavity.

d. Remove the block bearing O 80 and guide rod by removing the two binding head screws. Turn the RF OSC knob fully counterclockwise and swing the oscillator drive yoke free.

e. Unsolder repeller lead at the potentiometer mounting board, TB7, and remove the lead from the harness.

f. Remove barrel locknut H45.

g. Remove the inner conductor and choke assembly. Slide the choke off the inner conductor.

6—44. REPLACEMENT OF INNER CONDUCTOR AND CHOKE ASSEMBLIES. To replace the inner conductor and choke assemblies, proceed as follows:

a. Align the choke pushrods with the inner conductor clearance holes and push choke to the base of the inner conductor.

b. Set the breaks in the two white teflon outer bearings O 55 so that they do not line up.

c. Insert the choke assembly, Z10, into the barrel, Z1. Push the inner conductor all the way into the barrel.

d. Repeat steps d. through f. of paragraph 6—43 in reverse order. Do not tighten barrel locknut H45.

e. Refer to paragraph 6—65 and perform steps c. through h.

f. Tighten barrel locknut H45. Be careful not to twist choke pushrods.

g. Refer to paragraph 6—28 and replace the klystron.

6—45. REMOVAL OF OSCILLATOR AND GEAR BOX ASSEMBLY.

6—46. To remove the oscillator and gear box assembly, proceed as follows:

a. Refer to paragraph 6—25 and remove the klystron tube.

b. Remove the FREQUENCY IN KILOMEGACYCLES dial cover and the frequency dial.

c. Remove the RF OSC and LOCK knobs.

d. Perform steps b. through e. of paragraph 6—40.

e. Loosen the seven 4-40 nuts holding the solder lugs and attached wires at the side of potentiometer R59. Remove the nuts and lift the solder lugs away from the potentiometer. Remove cable clamps, solder lugs, etc. attached to gear box O 1, or oscillator barrel assembly.

f. Remove the two screws holding filter mounting plate to gear box. Unscrew from the front of the panel the three 8-32 binding head screws and the one 8-32 flat head screw holding the gear box to the rear of the panel and remove the oscillator and gear box assembly.

6—47. REPLACEMENT OF OSCILLATOR AND GEAR BOX ASSEMBLY. To replace the oscillator and gear box assembly, proceed as follows:

a. Perform steps b. through f. of paragraph 6—46 in reverse order.

b. Refer to paragraph 6—28 and replace the klystron tube.

6—48. ADJUSTMENT OF THE OSCILLATOR DRIVE ASSEMBLY. Adjustment of the oscillator drive assembly is required only if the oscillator assembly has been removed from the gear box. To adjust the oscillator drive assembly, proceed as follows:

a. Check to see that the metal inserts at ends of pushrods O 11 are centered in oscillator drive yoke and setscrews H41 are tight.

b. Loosen the two 6-32 setscrews holding the stop washer collar H18.

c. Turn the RF OSC knob clockwise until the choke depth is as noted in figure 6—7. LOCK the RF OSC knob.

d. Perform steps b. through f. of paragraph 6—49.

e. Tighten the two 6—32 setscrews on the stop washer collar.

6—49. REASSEMBLY OF STOP WASHERS. Reassembly of the stop washers is required only in the event that the stop washers have been loosened. To reassemble the stop washers, proceed as follows:

CAUTION

Remove the klystron tube to prevent its damage during this assembly operation.

a. Turn the RF OSC knob until oscillator choke is as noted in figure 6—7.

b. Remove all washers except the bottom flat washer and first stop washer.

c. Turn the first washer counterclockwise until it hits the stop pin and hold it in place.

d. Slip another stop washer on the shaft and turn the washer, in the same direction, until it locks against the first stop washer.

e. Assemble the remaining stop washers on the shaft, holding the top stop washer in each case to keep the stop washers from slipping over one another.

f. Place the stop washer collar, H18, on the shaft and set the tab of the top stop washer in the hole of the stop washer collar. Press down and turn counterclockwise. Do not release pressure.

Note

More than slight counterclockwise movement of the stop washer collar indicates that stop washers are not properly assembled.

g. Lock the stop washer collar with its two 6-32 spline head setscrews.

6—50. REMOVAL OF THE THERMISTOR AND ATTENUATOR DRIVE ASSEMBLY.

6—51. To remove the thermistor and attenuator drive assembly, proceed as follows:

a. Refer to paragraph 6—25 and remove the klystron tube.

b. Refer to paragraph 6—29 and remove the attenuator and power set dial assemblies.

c. Remove the Waldes retaining ring and washer from the front of the attenuator drive shaft. Push down on the attenuator drive rack to relieve the pressure from the pinion gear, and pull the attenuator shaft out of the assembly.

d. Remove the cable clamps which would interfere with the removal of the attenuator and thermistor drive assemblies.

e. Loosen the two 8-32 setscrews holding the thermistor yoke assembly O 7 to the thermistor drive shaft.

f. Carefully slide out the thermistor probe from the thermistor barrel.

g. Loosen the two 4-40 spline head setscrews on attenuator coupling O 12 and carefully withdraw the attenuator probe assembly from the attenuator barrel W5 and the attenuator coupling.

h. From the front of the panel unscrew two 10-32 flat head screws and the 10-32 binding head screw holding the thermistor and attenuator drive assemblies to the rear of the panel.

i. Carefully lift up and remove the thermistor and attenuator drive assemblies.

6—52. REPLACEMENT OF THE THERMISTOR AND ATTENUATOR DRIVE ASSEMBLIES. Replacement procedure for the thermistor and attenuator drive assemblies is the reverse of the removal procedure given in paragraph 6—51. After replacement with a new drive assembly, refer to paragraphs 6—59 through 6—62 and adjust the collar stops. Then refer to paragraph 6—57 and calibrate the power output.

6—53. CALIBRATION AND ADJUSTMENT.

6—54. GENERAL. The calibration and adjustment instructions given in this section of the handbook augment those of section V, but are required only in the event that one of the mechanical drives, the oscillator assembly or one of its sub-assemblies, the klystron tube, the FREQUENCY IN KILOMEGACYCLES dial, the ATTENUATOR dial or the POWER SET knob have been replaced.

6—55. CALIBRATING FREQUENCY IN KILOMEGACYCLES DIAL.

6—56. In order to calibrate the frequency dial, it is necessary first to remove the frequency dial cover on which a hairline is inscribed. A simulated hairline must therefore be made for accuracy of readings in calibration. When the dial light is removed, the simulated hairline may be drawn on the socket. Proceed as follows:

a. Remove the dial light and draw a line on the dial light socket directly up from the hairline.

b. Remove the dial cover.

c. Connect the signal generator as shown in figure 6—2.

d. Set the frequency dial to 2.30 kmc.

e. Set the frequency meter to 2.30 kmc.

f. Turn power ON. Set Function Switch S2 to CW and Output Switch S3 to DIRECT RF OUTPUT. Allow fifteen minutes for the signal generator to warm up.

CAUTION

Adjust POWER SET control to prevent meter needle from going off scale.

g. Rotate the RF OSC knob to give zero beat with the frequency meter. Lock the dial with the dial LOCK.

h. Loosen the three screws holding the frequency dial to the hub and using the pencil line as a hairline, reset the frequency dial to 2.30 kmc. If it is not possible to set the dial, it is necessary to reset the hub. Note the direction in which the hub must be moved. Remove the dial screws and dial. Loosen the two setscrews holding the hub to the shaft. Rotate hub to the proper position and tighten setscrews. Replace dial.

i. Check the calibration at the low end of the FREQUENCY IN KILOMEGACYCLES dial.

j. If the calibration does not meet the minimum standard for the low end, as noted in table XIII, set the

frequency meter to 1.00 kmc. Zero beat the signal generator with the frequency meter. Lock the dial with the dial LOCK.

k. Note the error (in kmc) on the FREQUENCY IN KILOMEGACYCLES dial. Loosen the three binding head screws and equalize the error. In other words, if the dial reading is *lower* than the frequency meter *add* ½ the error to the dial reading. If the dial reading is *higher* than the frequency meter *subtract* ½ the error from the dial reading. Turn dial to the equalized frequency and tighten the three binding head screws. Recheck the high end of the dial for the minimum standard as noted in table XIII. Repeat above procedure and equalize the error on both ends of the dial.

l. Replace the frequency dial cover.

6—57. CALIBRATING POWER OUTPUT.

6—58. To calibrate the power output, proceed as follows:

a. Follow the directions given in steps a. through m. of paragraph 6—6.

b. Set the FREQUENCY IN KILOMEGACYCLES dial at that frequency which is off standard.

c. Loosen the two setscrews holding the ATTENUATOR knob and remove the knob.

d. Use the 4-40 spline wrench supplied with the signal generator and loosen the two setscrews holding the attenuator dial hub to its shaft.

e. Check for zero set on meter M1.

f. Power set meter M1 (CAL position).

g. Take the difference between the two decibel readings found in step l. of paragraph 6—6 and convert one-half of that difference into milliwatts.

h. Turn the ATTENUATOR knob shaft until the power bridge meter indicates the milliwatt reading calculated above.

Note

Another method of determining the milliwatt level to which the ATTENUATOR knob shaft should be set is to put a mark for each db reading (step l. par. 6—6) beneath its number on the explanatory scale (fig. 6—6) and then to count the number of spaces between the two marks. Divide the number of spaces in half to get the final db number. The sign, + or — of the final db number will be the same sign as that of the larger db reading. Convert the final db number to milliwatts. This is the proper power output to which the power bridge meter is set.

i. Set the attenuator dial to "0" and tighten the two setscrews on the hub.

j. Replace the ATTENUATOR knob.

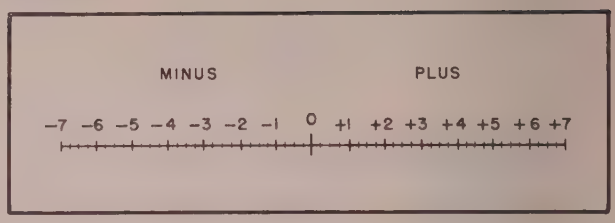


Figure 6—6. Explanatory Scale, Power Output Calibration

6—59. RESETTING THERMISTOR AND ATTENUATOR DRIVE STOPS.

6—60. The thermistor and attenuator drive stops are factory set and should not be reset except when a stop is loosened. When stops for both the thermistor and the attenuator drives must be set, start with the thermistor drive stops. See figures 5—2 and 5—3.

CAUTION

Do not rotate the POWER SET or ATTENUATOR knobs while a stop is loose except as directed below. The thermistor or attenuator probe tip may be damaged.

6—61. RESETTING THE THERMISTOR DRIVE STOPS. To set the collar stops for the thermistor drive, proceed as follows:

a. Turn the power ON and wait one minute.

b. Set Function Switch S2 to OFF.

c. Zero meter M1.

d. Set Function Switch S2 to CW.

e. Rotate the POWER SET knob to give approximately half-scale deflection of the meter pointer.

f. Turn the RF OSC knob so that FREQUENCY IN KILOMEGACYCLES dial is rotated from one end to the other. While the frequency dial is being rotated, note the frequency at which the lowest reading on meter M1 is obtained.

g. Set the frequency dial to the frequency giving the lowest reading.

h. Refer to *CAUTION* above. Rotate the POWER SET knob to give a maximum deflection of ¾ full-scale on meter M1.

WARNING

THE OPERATION OF THIS EQUIPMENT INVOLVES THE USE OF HIGH VOLTAGES THAT ARE DANGEROUS TO LIFE. REMOVE THE POWER BEFORE MAKING ADJUSTMENTS WITHIN THE UNIT.

i. Remove the power by disconnecting the power cord from POWER INPUT receptacle J1. Remove panel and chassis assembly (pars. 5—7 and 5—8).

j. Set upper collar stop O 3 against the upper side of drive support O 8 and tighten the two setscrews which hold the collar stop to the shaft.

k. Rotate the POWER SET knob clockwise until the thermistor yoke O 7 is out as far as it will go. Stop when the yoke is obstructed.

l. Set lower collar stop O 4 against the drive support assembly O 8 so that the thermistor drive stops just short of the obstruction, and tighten the two setscrews which hold the collar stop to the shaft.

6—62. RESETTING THE ATTENUATOR DRIVE STOPS. To set the stops for the attenuator drive, proceed as follows:

a. Replace power cord and put signal generator in operation as directed in steps a., b., c., and d. of paragraph 6—61. above.

b. Set the FREQUENCY IN KILOMEGACYCLES dial at the frequency giving the lowest power output, as directed in steps e., f., and g. of paragraph 6—61 above.

c. Rotate the POWER SET knob until the pointer of meter M1 deflects to CAL.

CAUTION

Do not move the ATTENUATOR more than necessary. Do not force. The attenuator probe or the klystron tube may be damaged.

d. Rotate the ATTENUATOR knob counterclockwise until the 0 dbm mark is just beyond the POWER SET window hairline.

e. Remove the power by disconnecting the power cord from POWER INPUT connector J1.

f. Adjust stop screw H10 so that it limits the downward movement of the attenuator and tighten the 8-32 hex lock nut which holds the stop screw fixed in position.

g. Set collar stop O 5 1/16 inch from edge and tighten the two setscrews holding the collar stop to the shaft.

6—63. ADJUSTING CHOKE ASSEMBLY.

6—64. Adjustment of the choke assembly is required only in the eevnt that the choke assembly has been removed from the barrel or when the frequency limits cannot be met.

6—65. To adjust the choke assembly to cover the frequency range noted in table XIII, proceed as follows:

a. Refer to paragraph 6—25 and remove klystron tube.

b. Unscrew and remove klystron retainer nut H50. Remove retainer washer H51 and the retainer spring H52 from the inside of the cavity.

c. Check to see that the metal inserts at ends of pushrods O 11 are centered in oscillator drive yoke and setscrews H41 are tight.

d. Turn RF OSC knob to extreme clockwise position. Set an inside type vernier depth calipers to the dimension shown in figure 6—7.

e. Use the shoulder inside the klystron end of the oscillator barrel assembly Z1 as a reference plane and insert the vernier depth calipers into the oscillator barrel. See figure 6—7.

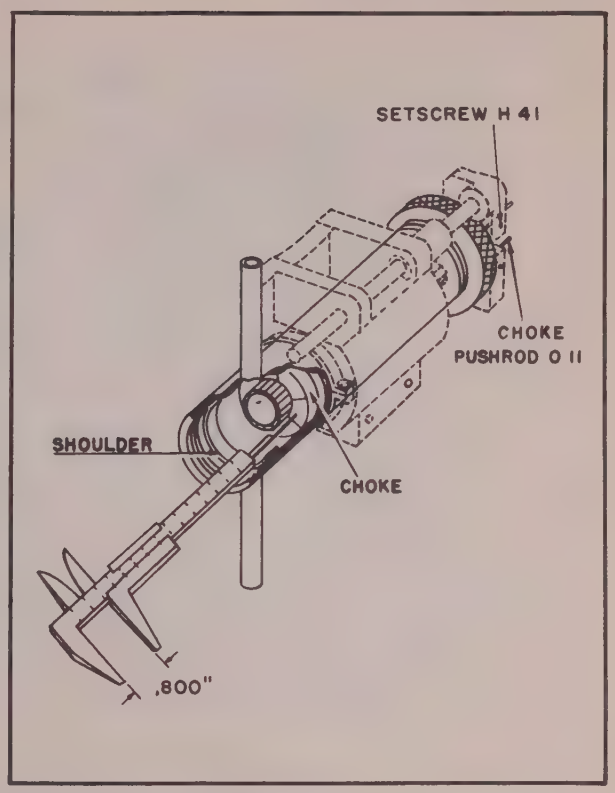


Figure 6—7. Assembly Showing Inner Conductor and Choke

a reference plane and insert the vernier depth calipers into the oscillator barrel. See figure 6—7.

f. If the depth does not check with that noted in figure 6—7, loosen setscrews H41 and slide the choke within the oscillator barrel by moving the choke pushrods (O 11) until the end of the choke meets the vernier calipers. If the depth checks, proceed with step i.

g. Tighten the two setscrews H41.

h. Recheck the measurement with the vernier depth calipers. Repeat steps f. and g. if necessary.

i. Replace the retaining components removed in step b. above.

j. Refer to paragraph 6—28 and replace the klystron tube.

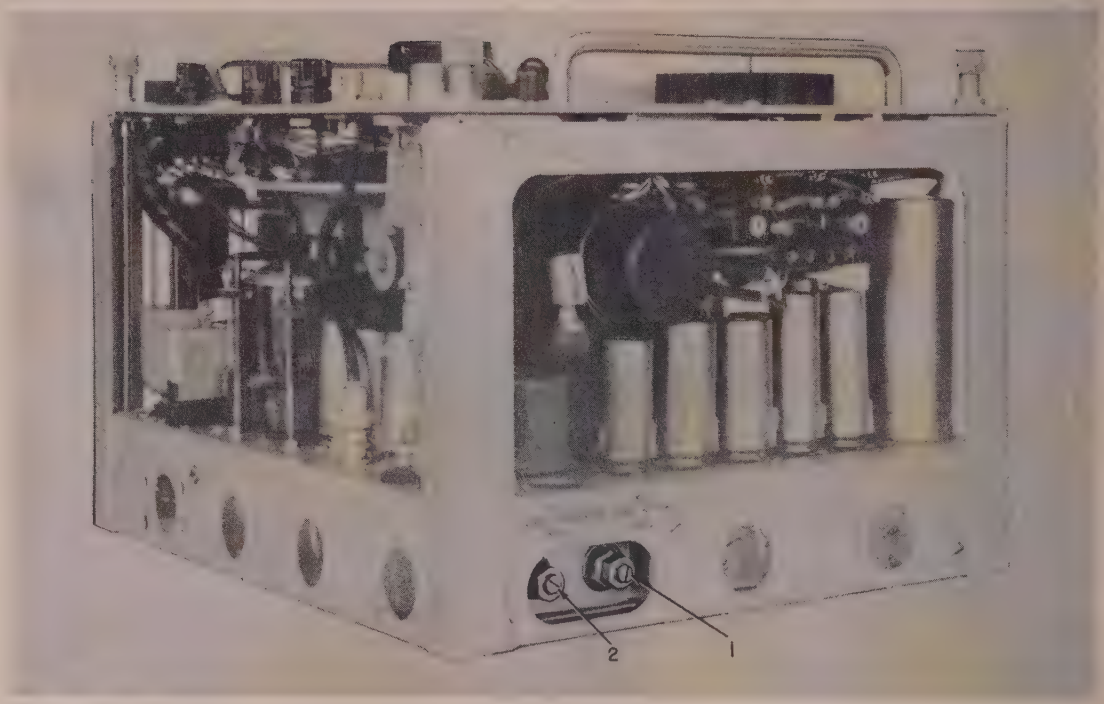
6—66. SETTING REPELLER TRACKING VOLTAGES.

6—67. The repeller voltages are first adjusted for maximum c-w power output at each of the tracking points. Final adjustment is then made for the proper pulse waveform at each tracking point.

6—68. TRACKING ADJUSTMENT FOR C-W OPERATION. To make the tracking adjustments for c-w operation, refer to figure 6—9 and proceed as follows:

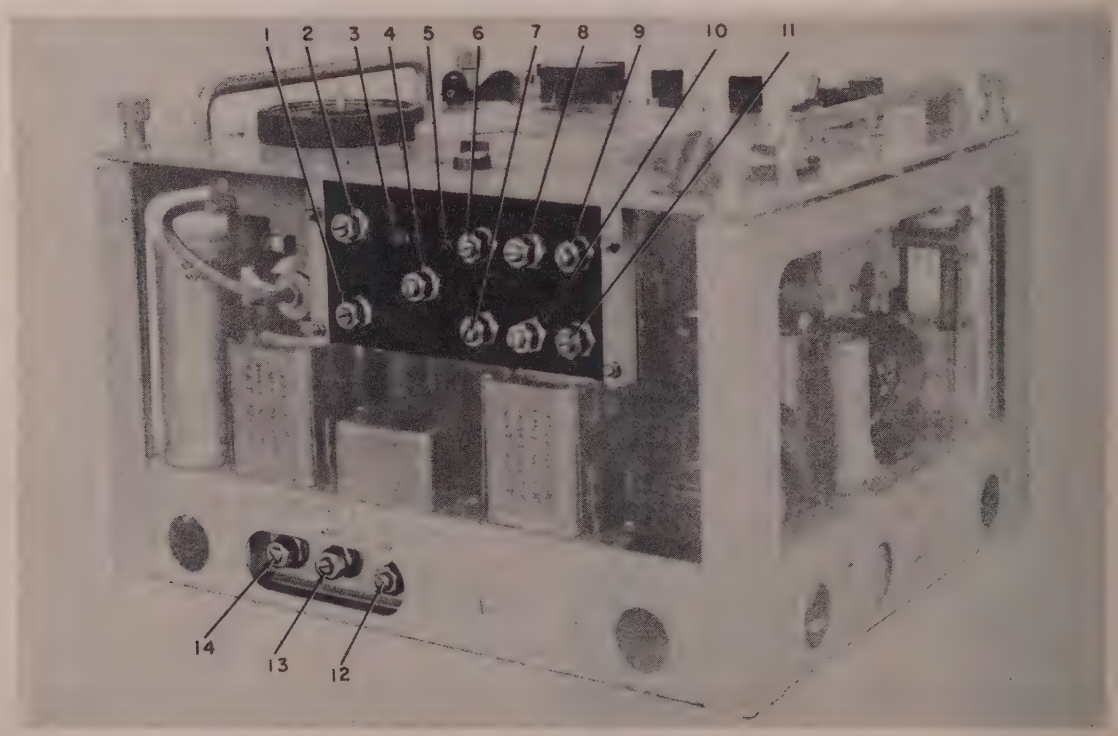
a. Connect a 20,000 ohm-per-volt d-c voltmeter from pin jack J7 on terminal board TB7 to test point 10 of test socket J5.

b. If the potentiometers have previously been adjusted for tracking, proceed with step c. If they have not previ-



1. REP RATE ADJ R12 2. BEAM CURRENT ADJ R26

Figure 6—8. Adjustment Controls, View No. 1



1. COARSE ADJ R63
2. LOW, R53
3. Test Point J6
4. TRACK 1 R55
5. Test Point J7
6. TRACK 2 R56
7. HIGH, R54
8. HIGH MODE R51
9. TRACK 3 R57
10. LOW MODE R52
11. TRACK 4 R58
12. —183 V ADJ R6
13. —325 V ADJ R83
14. —725 V ADJ R49

Figure 6—9. Adjustment Controls, View No. 2

ously been adjusted, set the tracking potentiometers (table XVII) in the center of their range.

c. Turn power ON and zero set meter M1.

d. Set Function Switch to CW.

Note

All potentiometer shafts are provided with shaft locks. Use a hexagon spintite wrench to loosen the lock before attempting to rotate the shaft. After satisfactory adjustment, lock the shaft and recheck the tracking voltage.

e. Refer to table XVII and adjust R54 by following steps 1 and 2.

f. Rotate the RF OSC knob from the high towards the low end until a click is heard at about 1.25 kmc. Note the frequency at which the click is heard. Rotate the RF OSC knob backward and LOCK dial as second click is heard. Adjust the HIGH MODE potentiometer R51 to give maximum deflection of meter M1.

g. Rotate the RF OSC knob counterclockwise (slowly) until the click is noted again. Adjust the LOW MODE potentiometer R52 to give maximum deflection of meter M1.

h. Refer to table XVII and adjust LOW potentiometer R53 by following steps 1 and 2.

i. Check the track settings by repeating steps f. through h. above.

j. Refer to table XVII and adjust tracks 1, 3, and 4.

k. Repeat steps f. through j. until each track is approximately at maximum without further adjustment. It may be necessary to repeat the adjustments several times.

Note

Track 2, R56, is set at the center of its range and not readjusted unless LOW MODE potentiometer R52 cannot set the required voltage noted in table XVII.

TABLE XVII. C-W REPELLER TRACKING VOLTAGES

Track	*Step 1 Set frequency dial to (kmc)*	*Step 2 Adjust for maximum reading on meter M1**	*Approximate Repeller Voltage (volts)*
HIGH	2.30	R54	220
HIGH MODE	Refer to step f. of par. 6—68.	R51	40
LOW MODE	Refer to step g. of par. 6—68.	R52	155
LOW	1.00	R53	90
1	1.08	R55	115
3	1.50	R56	80
4	1.87	R58	145

* *Note.* Adjust POWER SET control to maintain meter needle on scale.

6—69. TRACKING ADJUSTMENTS FOR PULSE MODULATED R-F OUTPUT. After adjusting the track potentiometers for the proper cw repeller voltages, check the waveshape of the pulse modulated r-f output and readjust the track potentiometers, if necessary. To check the waveshape and make the readjustments, proceed as follows:

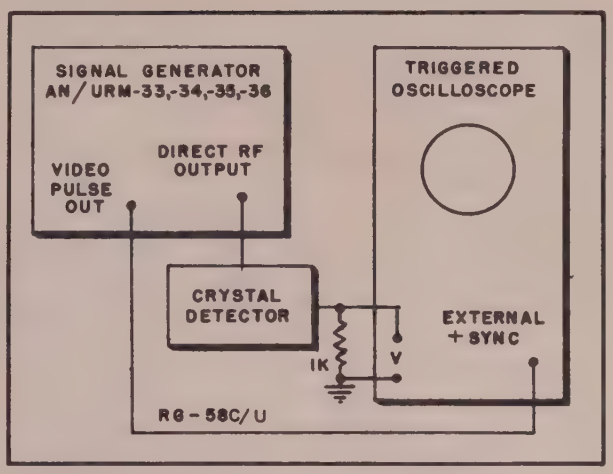


Figure 6—10. Test Set-up for Checking R-F Pulse

a. Connect the signal generator as shown in figure 6—10.

b. Turn power ON and allow fifteen minutes for warm-up.

c. Set frequency dial to the high end. Zero set and set the output reference level.

d. Set the function switch to PULSE. Adjust the oscilloscope controls to show a single pulse.

e. See figure 7—3 and check the waveforms. Note that the top of the pulse is flat. Compare it with the pulse on the scope.

f. If the pulse top on the oscilloscope is not flat, adjust R54 to give an optimum pulse shape.

g. Refer to table XVII and set the frequency dial to each of the track frequencies. At each frequency, set the output reference level. Set Function Switch S2 to PULSE and adjust the proper potentiometer for each frequency to give the proper pulse shape.

h. Set the dial at one end. Slowly rotate it checking the pulse shown on the scope for proper shape at all points on the dial. If necessary to correct between track points use the track potentiometer or potentiometers closest to the frequency requiring readjustment.

i. If the pulse wave shape is unsatisfactory between the frequencies at which LOW MODE* and track 2 are checked, adjust LOW MODE R52 for proper pulse shape. If necessary to adjust any potentiometer, recheck the waveform at all points on the dial.

6—70. TRACKING POTENTIOMETER WIPER AND MODE SWITCH ADJUSTMENT.

6—71. TRACKING POTENTIOMETER WIPER. The tracking potentiometer wiper is preset at the factory.

Adustment will normally be necessary only if the tracking potentiometer has been removed from the gear box or the stop collar assembly H18 has been readjusted. To adjust the tracking potentiometer wiper to its proper setting, proceed as follows:

a. Remove the FREQUENCY IN KILOMEGACYCLES dial cover and dial.

b. Remove one 8-32 binding head mounting screw and loosen the other so that the board, TB7, may be moved to permit access to the potentiometer gear, O 45. Loosen the two 4-32 spline head setscrews holdings the potentiometer drive gear to its shaft and LOCK.

c. Turn the RF OSC knob completely clockwise.

d. Connect an ohmmeter from the wiper (marked 2) to the high point (marked 3) on the potentiometer.

e. Turn the slotted shaft of the tracking potentiometer R59 until the ohmmeter reads 4,000 ohms. The slotted shaft is accessible through the hole in the front panel.

f. Tighten the two 4-32 spline head setscrews holding the potentiometer drive gear to its shaft.

g. Replace the terminal board.

h. Replace the frequency dial.

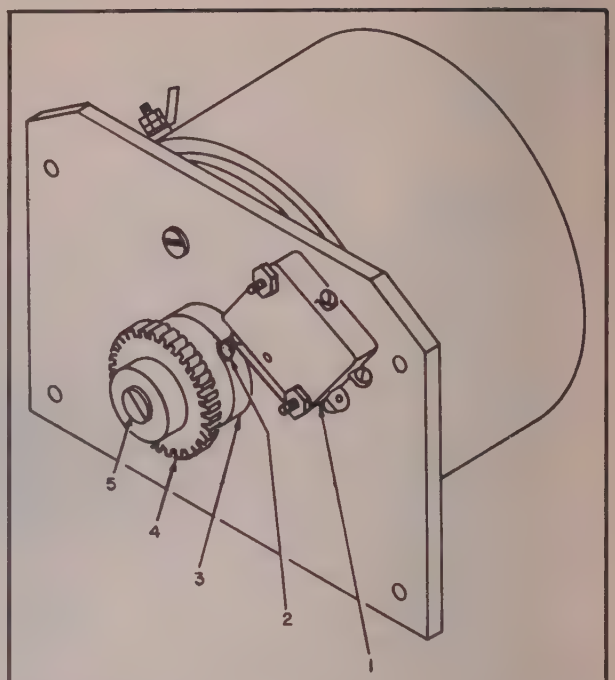
i. Refer to paragraph 6—55 and check the calibration of the frequency dial.

6—72. MODE SWITCH ADJUSTMENT. Adjustment of the mode switch is required whenever the cam H75 is replaced or loosened. To adjust, proceed as follows:

a. Perform steps a. and c. of paragraph 71.

b. Remove the tracking potentiometer mounting board assembly. Do not remove the drive gear or separate the potentiometer from the mounting board.

c. Connect an ohmmeter between the wiper and the 40% terminal. Rotate the tracking potentiometer shaft until there is a minimum reading on the ohmmeter and remove the ohmmeter leads.



1. MODE SWITCH S4
2. FOLLOWER
3. CAM H75
4. DRIVE GEAR O 45
5. SHAFT

Figure 6—11. Tracking Potentiometer

d. Loosen the two 4-40 setscrews which hold the cam, H75, to the potentiometer shaft. Turn the cam until the switch, S4, clicks and the follower is on the low side of the cam as shown in figure 6—11. Tighten the two setscrews.

e. Connect the ohmmeter between the wiper and the high terminal. Rotate the potentiometer shaft until the ohmmeter reads 4,000 ohms. Remove the ohmmeter leads.

f. Replace the potentiometer mounting board assembly, and check the setting of the potentiometer wiper adjustment (par. 6—19).

SECTION VII
DIAGRAMS

7—1. DIAGRAMS.

7—2. This section contains four illustrations. All symbols necessary for the proper understanding and use of the illustrations are included therein.

7—3. The following is a list of illustrations in this section.

Figure 7—1. Voltage Measurements
Figure 7—2. Resistance Measurement
Figure 7—3. Waveforms
Figure 7—4. Schematic Diagram

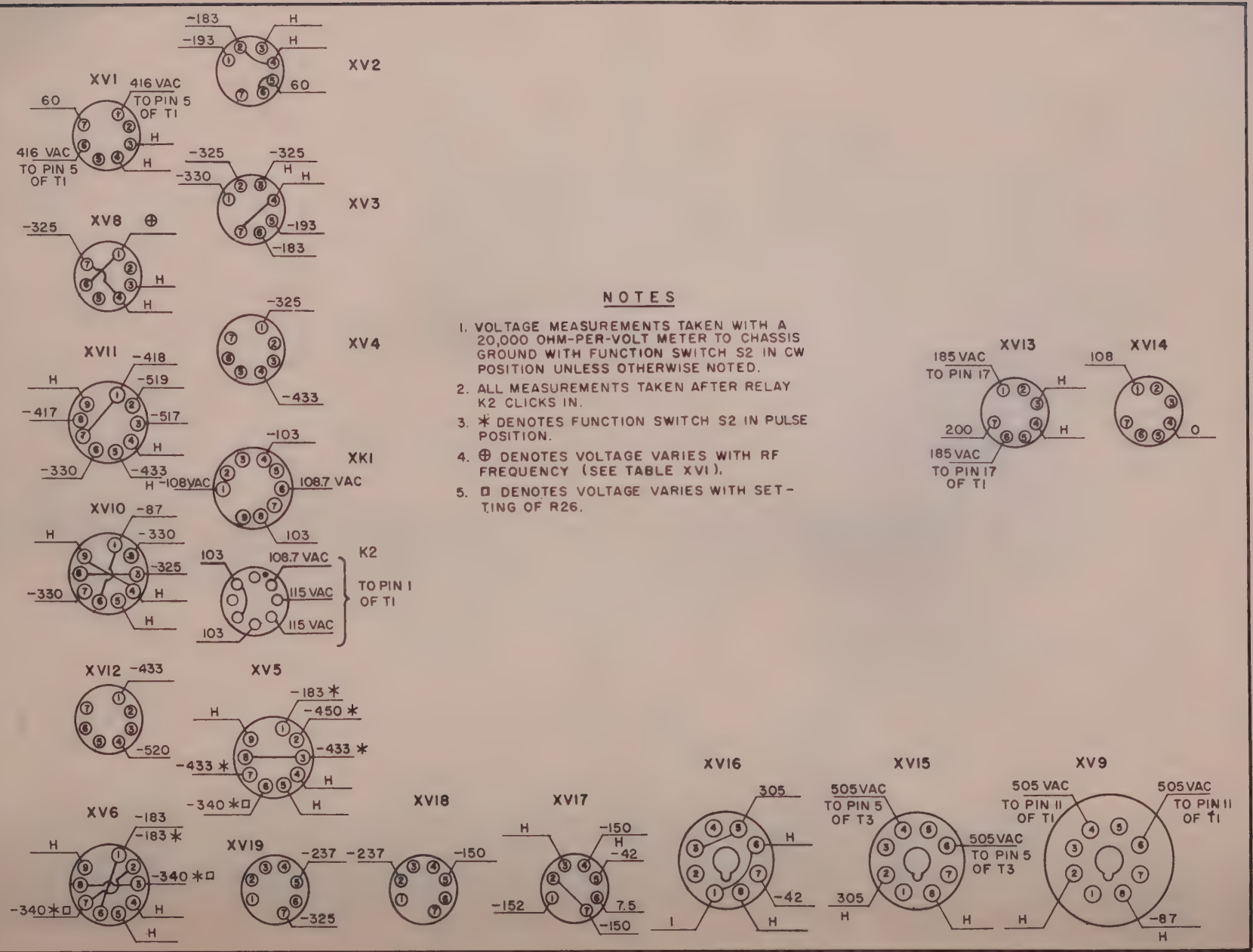
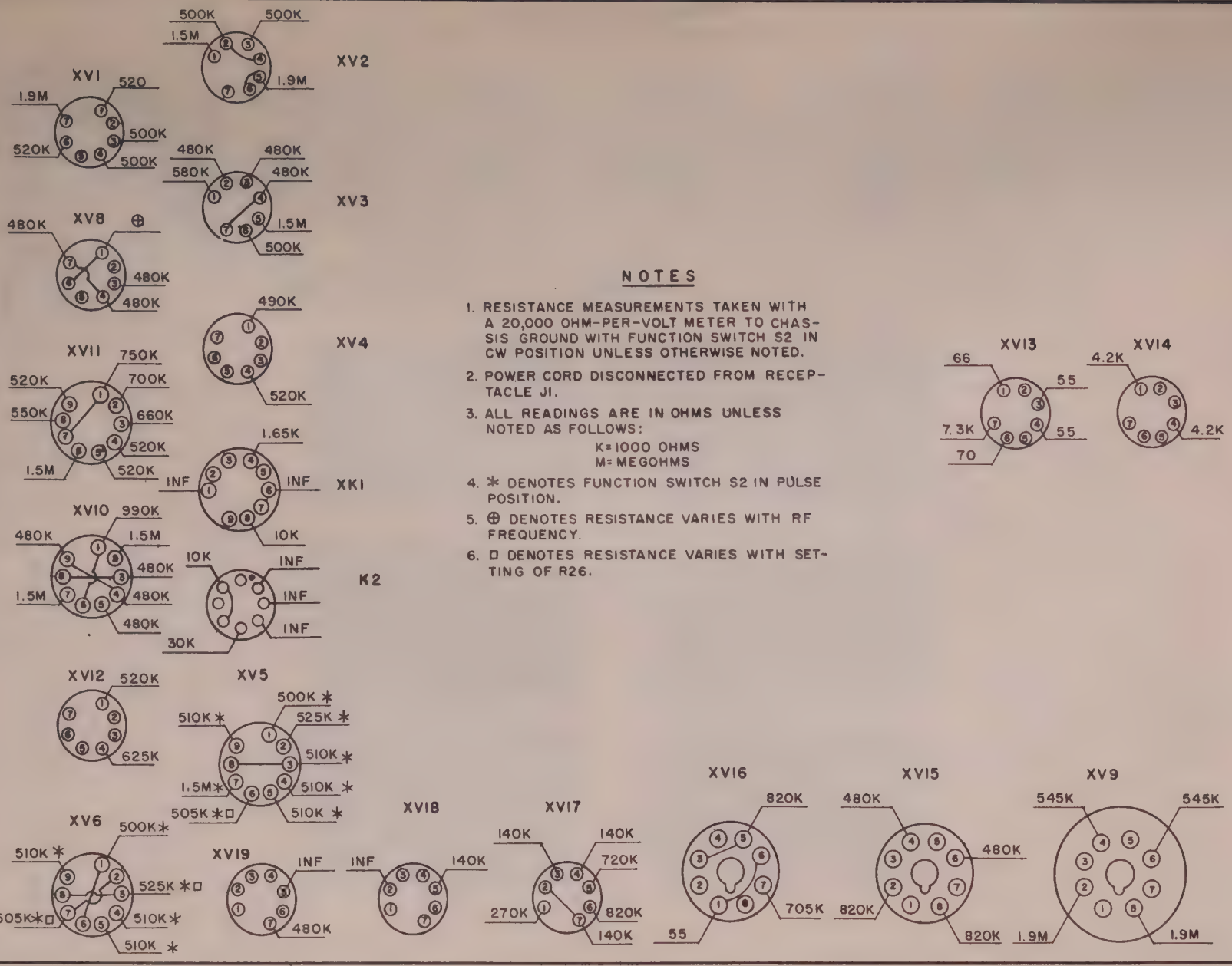


Figure 7–1. Voltage Measurements



NOTES

1. RESISTANCE MEASUREMENTS TAKEN WITH A 20,000 OHM-PER-VOLT METER TO CHASSIS GROUND WITH FUNCTION SWITCH S2 IN CW POSITION UNLESS OTHERWISE NOTED.
2. POWER CORD DISCONNECTED FROM RECEPTACLE J1.
3. ALL READINGS ARE IN OHMS UNLESS NOTED AS FOLLOWS:
   K=1000 OHMS
   M=MEGOHMS
4. ✱ DENOTES FUNCTION SWITCH S2 IN PULSE POSITION.
5. ⊕ DENOTES RESISTANCE VARIES WITH RF FREQUENCY.
6. □ DENOTES RESISTANCE VARIES WITH SETTING OF R26.

Figure 7–2. Resistance Measurements

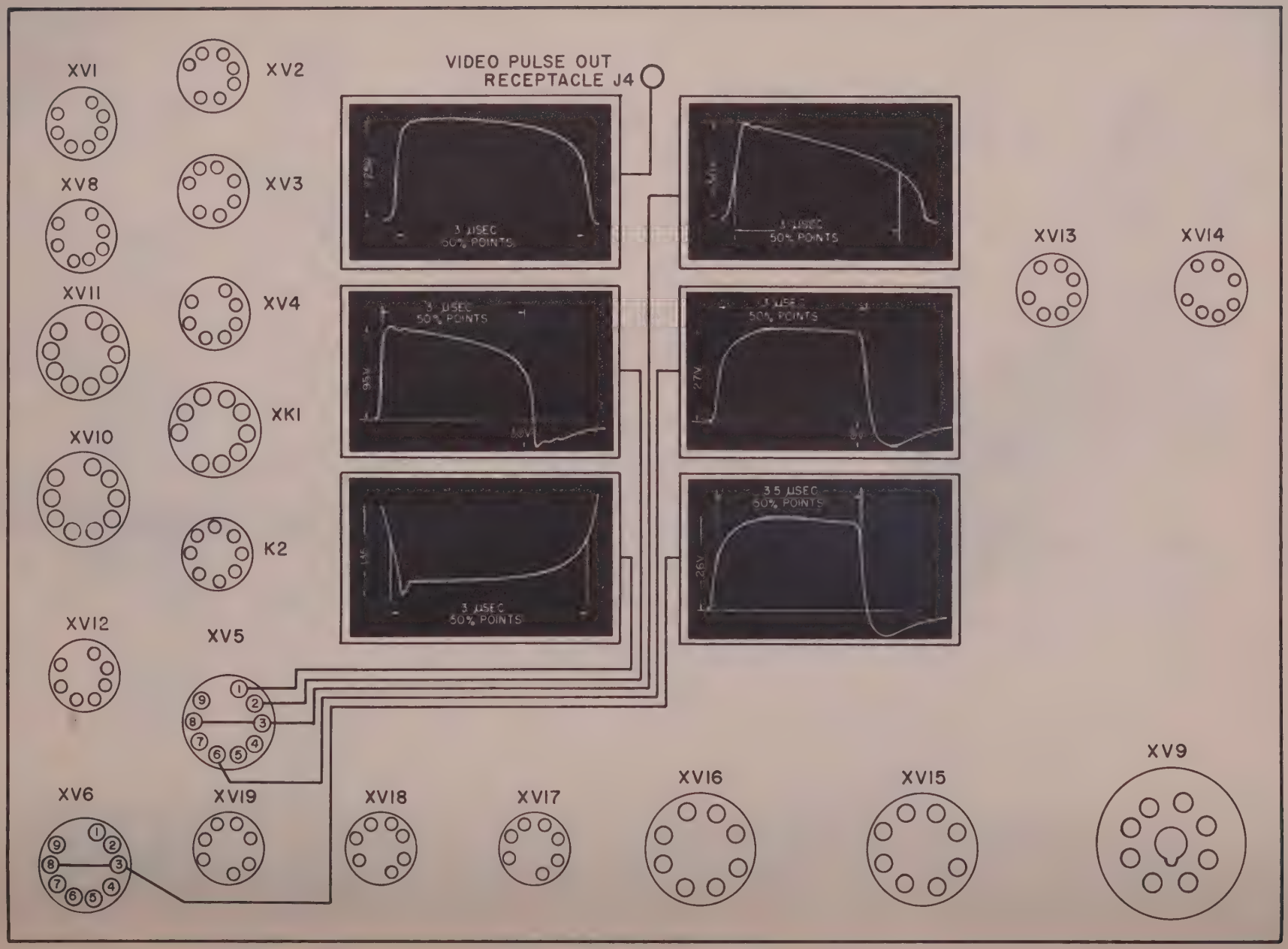
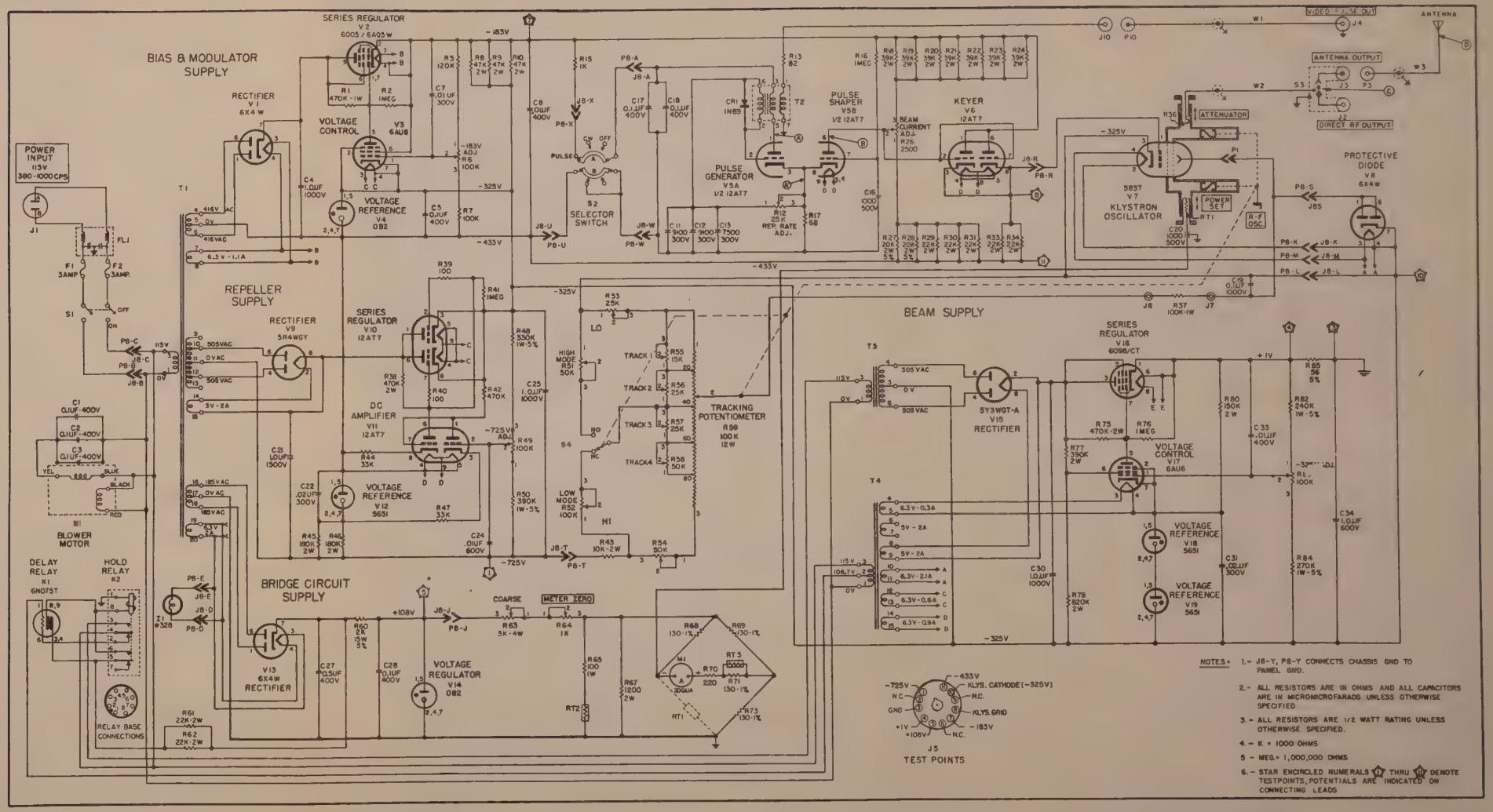


Figure 7–3. Waveforms



NOTES:

1. - J8-Y, P8-Y CONNECTS CHASSIS GND TO PANEL GND.
2. - ALL RESISTORS ARE IN OHMS AND ALL CAPACITORS ARE IN MICROMICROFARADS UNLESS OTHERWISE SPECIFIED
3. - ALL RESISTORS ARE 1/2 WATT RATING UNLESS OTHERWISE SPECIFIED.
4. - K = 1000 OHMS
5. - MEG = 1,000,000 OHMS
6. - STAR ENCIRCLED NUMERALS (1) THRU (19) DENOTE TESTPOINTS, POTENTIALS ARE INDICATED ON CONNECTING LEADS

Figure 7—4. Schematic Diagram

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